THE MEDICAL JOURNAL OF AUSTRALIA

VOL. II.—28TH YEAR. SYDNEY, SATURDAY, NOVEMBER 29, 1941. No. 22

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The Charles Mackay Lecture.

THE BIOLOGICAL APPROACH TO INFECTIOUS DISEASE.

By F. M. BURNET,
Melbourne.

THIS lecture was endowed by Miss McKenzie to honour the memory of her grandfather Charles Mackay. He was a Scottish schoolmaster from Sunderland, who reached Melbourne in 1852 and died eleven years later. He came to Australia on the ill-fated emigrant ship *Ticonderoga*, and took a notable part in maintaining discipline and hope amongst the passengers during the disastrous ship-board epidemic of typhus fever that caused no less than 168 deaths during the voyage. Before leaving Scotland he had been offered the position of vice-principal of Scotch College, which had been founded in Melbourne in the previous year. He preferred, however, to work in the country town of Kilmore, where there were many settlers from his native Highlands. Here he spent the rest of his life, leaving behind him the memory of a man whose integrity of character, learning and religious faith were worthy of the race from which he had sprung.

It has been usual in these lectures to take as a subject some aspect of medical history or some past or present problem of social life as viewed from a medical angle. In many ways I should have preferred to follow this tradition more closely than I have and to find my subject somewhere in the history of infectious disease. However, I had to accept this invitation at rather short notice, and I felt that in the circumstances I could deal more satisfactorily with a theme more closely related to my actual work. Even so, I think that I can best introduce my chosen subject of the biological approach to infectious disease by a brief historical discussion of earlier ways of looking at its problems.

[1] Delivered at the Australian Institute of Anatomy, Canberra, on September 29, 1941.

Theories of Infectious Disease.

We must recognize at once that we cannot expect to find any comprehensive theory of infectious disease before the scientific period. There was first of all the difficulty of knowing which diseases were infectious in the modern sense. Human disease is so complicated and diverse in its manifestations that it took centuries to sort out the phenomena into more or less distinct entities—and in fact this process of sorting out is still going on. Even if in the Middle Ages it had been possible to recognize clearly the diseases we now call malaria, scurvy, tuberculosis, rickets, typhoid fever, and that common mediæval occurrence when the rye harvest was poor—ergot poisoning—it would still, I think, have been impossible to say which, if any, of these diseases were infectious.

It is interesting that during the classical period the idea of contagious disease was much more clearly expressed by lay writers than by medical writers and philosophers, and right up to the nineteenth century there was a general tendency to regard contagiousness as a rather unimportant secondary phenomenon and to theorize on the underlying primary causes which might be responsible for the initiation of epidemics.

Perhaps we can divide the phases of thought on these underlying causes of epidemics into four. The earliest is naturally that which ascribes epidemics to frankly supernatural causes, the darts of Apollo which inflicted disease on the Greeks besieging Troy, or the Angel of the Lord who went out and smote in the camp of the army of Sennacherib (in all probability the same malignant malaria of the Jordan valley which played such a part in Allenby's campaigns). In the introduction to "The Decameron" we

find Boccaccio stating that there were two popular views at the time in regard to the origin of the black death of 1348: one ascribed it to the operation of the heavenly bodies, another regarded it as "sent down upon mankind for our correction by the just wrath of God". Yet Boccaccio was quite clear about the contagiousness of the disease. The narrators of the tales in "The Decameron" were themselves refugees from Florence, who had shown their practical belief in the theory of contagion by fleeing from the city to an isolated country house.

Long before the supernatural theories had been abandoned, another dominant theory was arising which persisted into the beginning of the bacteriological era. This ascribed epidemics to changes in the air, which in their turn were often supposed to be induced by changes of various sorts which took place beneath the surface of the ground. In its original Hippocratic form, developed in the eastern Mediterranean, this doctrine probably arose from the seasonal incidence of malaria, with its obvious correlation with climatic and regional conditions. After all, it is perfectly true that in the last analysis the temperature, humidity and rate of movement of the air determine whether the *Anopheles* mosquito can infest a given locality. Later on, the real and imaginary menaces to health of decomposing bodies and human filth were naturally enough ascribed to contamination of the air with the effluvia that were so offensive to the nose. So there developed a general miasmatic theory of infectious disease, which was modified in various forms according to the ingenuity of the philosophers and the circumstances requiring explanation. A popular form was to associate floods and earthquakes with disturbance of buried corpses and liberation of pestilential miasmata into the air. The great plague of Justinian's reign was very circumstantially supposed to have arisen in the neighbourhood of that "great Serbonian bog where armies whole have sunk" in the Nile Delta.

When we come to more modern times it is perhaps only natural that one of the founders of chemistry, Robert Boyle, should give a chemical twist to the already ancient theory. He saw the origin of epidemics as a result of the subterranean activity of "orpimental and other mischievous fossils". As a distressing example of how far astray an extremely intelligent man can go when he deals with matters outside the contemporary range of experimental study, the following quotation from Boyle may be salutary:

> Some among the emergent variety of exotic and hurtful steams may be found capable to disaffect human bodies after a very uncommon way and thereby to produce new diseases whose duration may be greater or smaller according to the lastingness of those subterraneal causes that produce them. On which account it need be no wonder that some new diseases have but a short duration and vanish not long after their appearing, the sources of fumes being soon destroyed or spent; whereas some others may continue longer upon the stage as having underground more settled and durable causes to maintain them.

During the eighteenth and early nineteenth centuries the association of typhoid fever with insanitary conditions was clearly recognized, and although the practical men who gave England decent drains had no interest in germs and thought they were preventing disease by removing bad smells, the result was just as satisfactory. In the middle of the nineteenth century first diphtheria and then scarlet fever became much more prominent as causes of death among children than they had previously been. Both, but particularly diphtheria, were popularly ascribed to "bad drains", and one still occasionally comes across this superstition. The last exponent of the miasmatic school of epidemiology was Charles Creighton, who finished his classical "History of Epidemics in Britain" in 1892. Despite the fact that many important bacteriological discoveries had been made by Pasteur, Koch and their first collaborators, Creighton still persisted that the bacteriologists saw only a small fraction of the whole problem raised by infectious disease. Perhaps Creighton had too much of the scholar's contempt for the intellectual crudities of young men sounding a new science. Nevertheless I have found that to read Creighton carefully is a most stimulating exercise for a bacteriologist. He supported a now completely discredited theory; but his attacks on what was then just becoming the orthodox germ theory of infectious disease were penetrating and are only now being answered.

The third approach to infectious disease is of course that which developed in the exciting days of the 1880's, when Pasteur and Koch were opening up that strange new world of invisible but immensely important microorganisms. Koch was the dominant figure in building up the new conceptions that grew into the germ theory of infectious disease. The essence of the new theory can best be gathered from what every student of medical bacteriology knows as "Koch's postulates". These are the conditions which, according to Koch, had to be fulfilled before a microorganism could be accepted as the cause of a given disease. First, it must be present in the affected tissues of all subjects of the disease. Secondly, it must not be found in normal subjects or in those suffering from other types of disease. Thirdly, it must be isolated in pure culture, and after several generations of growth outside the body it must be capable of producing the specific disease when suitably administered to a susceptible animal.

For each infectious disease there was a specific microorganism responsible, and conversely the activity of each disease-producing microorganism resulted in a specific disease. This was a good clear-cut working hypothesis, and its application led to the rapid discovery of the bacteria responsible for diphtheria, typhoid fever, pneumonia, tetanus, cholera, tuberculosis and septic infections. In one sense the conceptions of Koch and Pasteur have never been superseded; we still believe that all cases of tuberculosis are due to infection with the bacillus that Koch described in 1882, and that about 90% of cases of lobar pneumonia are due to one or other form of the pneumococcus. Nevertheless, I think that during the present century there has been a progressive change in the general outlook on infectious disease, so much so that it is not inappropriate to say that the early germ theory has been replaced almost unconsciously by what may be called the biological approach to infectious disease. This changed approach has developed gradually and has, I think, been due largely to the fact that for the effective study of many important diseases, like plague and malaria, a wide biological knowledge and a grasp of ecological principles were necessary.

It is a popular modern doctrine that the development of the natural sciences has been largely moulded by practical human needs. The study of infections has a particularly obvious application to human welfare, and there has perhaps been a tendency to concentrate wholly on the medical aspects and to forget that infectious disease is a process involving the interaction of two species of living organisms. Man and microbe are both, as it were, struggling for survival, and both demonstrating by their very existence past success in this struggle to survive.

The Ecological Point of View.

Along with medical bacteriology there has developed in the last fifty years another science concerned with the interaction between living organisms—ecology; and it is the main theme of my talk that nowadays we must approach infectious disease of man or animals much more from the ecological point of view than we have in the past. Ecology is no less concerned with human needs than is bacteriology, a point I need hardly stress in Canberra, when a very large proportion of the work in the various biological divisions of the Council for Scientific and Industrial Research is directly concerned with ecological problems. It is to man's advantage that certain species of animal or plant should flourish and multiply. It is equally so that caterpillars and grasshoppers, thistles and bracken, and all the other pests that have afflicted mankind since the ten plagues of Egypt, should be prevented from excessive proliferation. It is the task of the practical ecologist to determine the factors responsible for the changing numbers of a given species in some environment which is deemed important for human needs.

Every ecological problem is in a sense unique; but behind them all there are certain general attributes of life which determine the broad lines of investigation required. In the first place, every living species requires

a certain amount of food in a form appropriate to its need; secondly, it must dwell in an environment whose physical characteristics—temperature, humidity *et cetera*—are within its range of tolerance. If these conditions are fulfilled and no other factors intervene, multiplication of the species will occur until the increase is checked by failing food supply. Proliferation to this extent, however, is extremely rare, for the simple reason that the tissues of every organism, plant or animal, can be utilized as food by some other species. You are all familiar with the ultimate dependence of all animals on some form of green plant, terrestrial or marine, for food. Some feed directly on plants; for others there may be a complicated "food chain" between the final consumer and the green plant. A seal lives on large marine fish which live on smaller fish; these feed on various forms of animal plankton, larval crustacea perhaps, which in their turn subsist mainly on the microscopic green algæ which provide the ultimate nourishment for all sea creatures. At the end of every "food chain" there are large organisms—shark, tiger, elephant, man, for example—which for one reason or another are normally immune from the attack of predatory enemies. But even these are not outside the incessant struggle for food; parasites and semiparasites find a food supply where they can, and though the tiger may dominate the jungle, that does not always prevent his lungs from being riddled with parasitic flukes. To survive, an animal species must in general find an adequate food supply and an adequate defence against both predators and parasites.

But I should like now to turn more to the struggle for survival as it affects the parasite, and in particular to discuss from this point of view that dominant class of parasites, the bacteria. Bacteria have, of course, a far more important place in the scheme of things than the function of mere bearers of disease. Without them all the material available for the construction of living tissue would soon be locked up in the dead, undecaying bodies of plants and animals. There are bacteria which can utilize for food every conceivable type of organic matter, with not even the exception of the bodies of other bacteria. The final result is the disintegration of all organic refuse into humus and the simple inorganic molecules from which the green plant builds its tissues.

This scavenging function of bacteria gives, I think, the clue to the process by which many members of the group have become parasites. As a necessary result of having evolved in a world crowded with bacteria all living animal cells are to a large degree insusceptible to invasion by unspecialized bacteria. But in man and most other animals there are various sources of food for bacteria apart from actual living cells. In the first place there are the food residues in the intestinal tract, which support an immense population of bacteria; then there are the dead cells which are continually being thrown off from the skin, or the surface cells which cover the tongue, throat, inside of the nose and so forth. These sources of food are inevitably exploited by bacteria, various types of which colonize the bowel contents, the mouth and throat and the skin. None of these bacteria normally produce disease; but it is significant of the origin of disease-producing bacteria when we find that the commonest cause of boils and other skin infections is a germ, the *Staphylococcus aureus*, that is closely related to the normal white staphylococci of the skin; that the causes of the characteristic bowel diseases, dysentery and typhoid fever, are bacteria quite closely related to the commonest normal type of intestinal bacillus; and that many infections of organs and passages in close relation to the throat are due to bacteria similar to or apparently identical with types that normally carry on a harmless existence in the throat. The inference is, of course, that bacteria which originally lived only at the expense of cell débris have on occasion become capable of obtaining their food requirements from living cells in the immediate neighbourhood of their normal habitat.

This change in habits of bacteria toward parasitism may be very slight, damage to living cells being produced only when other favouring conditions (for example, injury to the part) are present, or it may go on until the organism is capable only of a strictly parasitic existence. Often we can observe several stages of this process. For instance, there are bacilli which look extremely like the tubercle bacillus, but live harmlessly in the débris that accumulates in folds of the skin. The tubercle bacillus is a true parasite; but it can be grown quite easily on relatively simple mixtures of non-living materials. The bacillus of leprosy is also almost indistinguishable in appearance from the tubercle bacillus; but it is a much more specialized parasite. Within the leprous individual it is found almost wholly inside living cells, and no one has yet succeeded in growing the bacillus on any artificial culture medium.

Viruses and Virus Disease.

It is probable that this process of parasitic specialization may go on even further and give rise to those extraordinarily interesting fragments of living matter, the viruses. The nature of viruses is still being hotly debated; but on one point all are agreed—that all the available evidence indicates that viruses, like living organisms generally, are derived only from preexisting viruses of like but not necessarily identical character. They must then have an evolutionary history, and two main suggestions have been made as to its character; one is that viruses are the surviving descendants of one of those earliest steps in evolution which must have preceded the appearance of cellular organisms; the second, and I think much more probable hypothesis, is that viruses are descendants of larger microorganisms reduced by a process of parasitic degeneration.

Viruses and virus diseases have been the subject of my own professional activity for the last eight or nine years, and I may perhaps be permitted to discuss them with a little more detail than is strictly relevant to my present subject. They have, of course, a special interest to anyone who is in any degree interested in the philosophical implications of science, since they are situated in that no-man's land between non-living molecules and the smallest indubitably living organisms. Viruses may be defined as self-reproducing agents of disease, which are considerably smaller than bacteria, and which can multiply only in the living cells of a suitable host. They are responsible for a variety of human, animal and plant diseases; influenza, infantile paralysis, dog distemper and mosaic disease of tobacco are a few familiar examples. Although all viruses are smaller than bacteria, there is a considerable range in the sizes represented. A few are large enough to be seen quite readily with any good high-powered microscope. If we take an ordinary bacterium like the staphylococcus that produces boils, to have a diameter of one unit (actually it is approximately $^1/_{1000}$ of a millimetre, $^1/_{25000}$ of an inch), the range of virus diameters extends from about one one-hundredth of this unit for the virus of infantile paralysis to one-third for the virus of psittacosis. The smallest viruses are actually smaller than some of the larger protein molecules, and several of the plant viruses have been isolated in sufficient amount for physical chemists to show that the unit particles can be legitimately described as large molecules. At the other end of the scale there are viruses which have similar general properties to bacteria in their reactions to stains and the like. There is even one virus, typical in other respects, which can be inactivated by sulphanilamide according to the same process as bacteria. This is enough, I think, to indicate how impossible it is at present to say in this field where to draw the line between protein molecule and microorganism.

But in this lecture I am not concerned with the actual nature of viruses so much as with their interaction with the susceptible host cells, which gives rise to the phenomena of disease. In all these biological reactions viruses behave as if they were microorganisms of the same general quality as bacteria or protozoa. It is as legitimate to speak of a virus as an organism when we are studying its biological attributes as to call it a protein molecule when we are interested in its physical or chemical qualities.

Biologically a virus particle is to be regarded as a stage toward the ultimate in parasitic degeneration. It is

common knowledge how many of the parasitic forms of larger organisms become reduced till they are little more than a means of absorbing enough nourishment from the host to allow the development of reproductive cells. A hydatid cyst is a featureless bag of tissue, from the inner lining of which there develop hundreds of thousands of embryos. There is a parasitic tropical plant, *Rafflesia*, which has lost all semblance of a normal flowering plant, without chlorophyll, without a stem, leaves or roots. It is a mere network of fungus-like tubes which permeates the tissue of the tree it parasitizes, and at intervals gives rise to a single enormous flower three to four feet in diameter. However viruses may have evolved, what we observe of their behaviour sugests that they represent the biological limit of such parasitic degeneration. Within the tiny space of a bacterium there is packed the extraordinarily complex battery of ferments that is needed to convert the food molecules of its environment into its own structure. The smaller viruses have dispensed with all these necessities of an independent life, and only bare nucleoprotein molecules, the carriers of their hereditary characteristics, remain. In some way these living molecules possess the power of stealing the necessary material for their proliferation from the host cell, and it is from the disorganization of cell processes by this theft that the lesions and symptoms of virus disease arise.

I have given this account of the probable evolution of parasitic habit in bacteria and viruses only in broad outline. It could be filled in in considerable detail, and a rather similar but somewhat more speculative picture could be drawn of the evolution of the parasitic protozoa and fungi. But such elaboration is quite unnecessary. My aim has been to show that parasitism by microorganisms is a typical aspect of that struggle to survive and multiply, to eat and to avoid being eaten, which is life.

So far I have been concerned much more with the microorganism than with the host; but it is quite obvious that any development of power to feed on living tissue by a parasite or potential parasite must be in some way countered by the host species if it is to survive. The defence mechanisms of the human or animal body are complex, subtle and efficient. Their study has given rise to the science of immunology; but I shall make no use of this great mass of detailed knowledge in regard to how the cells and fluids of the body can prevent or minimize damage by parasitic microorganisms. It is enough to make two general statements about these defences: first, that every animal, including man, has a considerable inborn power to resist infection of any type, and second, that this power can be increased, often enormously, as a result of experience. Any child who has not had measles has more than a 50% chance of contracting it if he spends an hour or two near another child in the early stages of the disease; but if he has once had it the chance of a second attack at any time in his life is exceedingly small. Measles is rather an exceptionally clear-cut instance; but in general it is known that the successful overcoming of any type of infection results in an increase in resistance to subsequent contact with the corresponding type of microorganism. The degree and duration of this increased resistance vary greatly from one type of germ to another. Further, there is some evidence that repeated experience of this sort may increase resistance even against types of microorganism which have never been encountered previously.

Infectious disease has wider aspects than those which concern the struggle between the individual and the microorganisms which invade his tissues. Each disease presents a certain characteristic pattern in its incidence on the community, and the study of this pattern is the province of epidemiology. In epidemiological work we are concerned with such matters as the distribution of disease in relation to age, sex and social environment, with the development of epidemics, and with the factors underlying the persistence or disappearance of given diseases. It is in regard to these epidemiological matters that a wholehearted utilization of the ecological point of view is particularly helpful.

In any given environment, where climatic conditions are stable and there is no human interference with the course of Nature, the various animals and plants tend to reach a fairly stable balanced equilibrium, in which the rate of reproduction of each species is just sufficient to replace losses. There are several automatic controlling factors that go to maintain this balance. Any excessive increase of one particular type of animal will make it progressively easier for both its predatory and its parasitic enemies to flourish. If small rodents increase greatly in numbers, carnivores will find abundant food and in their turn breed freely, so that in the following year there will be a greatly increased onslaught on the rodents. Similarly, any increased density of population will favour the spread of parasites of all types, with a consequent increase in mortality. From their nature these controlling factors will tend to produce not so much a stable equilibrium as a more or less regular periodic swing on either side of an average value. These uneasy equilibria can obviously be greatly disturbed by the introduction of some outside factor, and the phenomena of mouse plagues, caterpillar plagues and the like may result.

I suppose the earliest ecological document in existence is the account of the ten plagues of Egypt. The first four at least probably represent an actual series of happenings. The turning of the water of the Nile to blood is obviously a primitive way of describing an overgrowth of red algæ in the water. We might guess than this overgrowth was dependent on an increase in the concentration of phosphates or nitrates in the water, such as might result when flood waters from some normally arid region entered the Nile. With an exceptional amount of this basic food material in the water, insect larvæ, frogs *et cetera* would flourish, and we might well expect the second, third and fourth plagues of frogs, lice and flies. Whether or not this is the way in which the plagues of Egypt developed, it is at least a perfectly typical account of the way an apparently minor change in the environment may wholly alter the balance of Nature.

The struggle for survival as it involves a microorganismal parasite and its host takes on very much the same form as that seen amongst carnivores and their prey. If the parasitic species is to survive, it is obviously essential that its activity should not be such as will lead directly or indirectly to the extinction of the host species. In fact, the less damage it does to the host, the greater its chance of survival, provided that it still retains power to infect fresh individuals. From the parasite's point of view the optimal condition is that every individual of the host species should become infected without suffering serious damage, and that this condition should be perpetuated by some efficient method of transferring infection to the next generation. There are one or two diseases in which this desirable equilibrium has been actually reached, and all my experience and reading go to suggest that this is the goal towards which all infectious diseases, left to themselves, would evolve.

As examples of diseases which have practically attained this goal, I shall give a short account of two types of virus disease that I have studied.

Psittacosis and Herpes.

The first is psittacosis—parrot fever—a serious, often fatal disease, typically seen in middle-aged or elderly women who have cherished a sick parrot. As a medical bacteriologist I am extremely interested in the problem of human psittacosis; but as a biologist I am far more interested in the natural history of psittacosis virus infection amongst parrots. Before 1934 it was currently believed that our Australian parrots were free from psittacosis infection; but in that year there were definite hints from overseas that Australian parrots were reaching England and America with the disease, and I was asked to investigate the position here. My first action was to purchase a dozen or two grass parrots from the nearest birdshop; more than half of them contained living psittacosis virus and others showed evidence of past infection. At the time this seemed a little staggering; but further experience with a large variety of parrots and cockatoos soon reconciled us to the fact that psittacosis infection is extremely widespread throughout the wild parrots of Australia. Infected birds were obtained from every

State except Western Australia, and from all the commoner species, including cockatoos and lorikeets.

When our experience with wild birds is combined with studies made in budgerigar aviaries in California, the standard life history of psittacosis virus is as follows. Young birds are infected in the nest from their parents; the infection is mild and may not even produce symptoms, but the virus enters the blood and lodges in the spleen and kidneys. The bird recovers; but it has an enlarged spleen and excretes small amounts of living virus from the kidneys, so eventually allowing infection of the next generation. That is the standard condition of balanced equilibrium; but it is not in the nature of things for such balances to persist indefinitely. Since this first work on psittacosis in Australia was done, two interesting breakdowns in the equilibrium condition have been observed. One of these was associated with a small outbreak of human psittacosis in a Melbourne suburb. A small dealer had received a consignment of 20 white cockatoos from the country, and while they were awaiting purchasers they were kept under filthy conditions in a small shed. They were apparently healthy when received, but at the time of our investigation a few weeks later several had died, and most of the rest were obviously ill and were in fact suffering from severe psittacosis. From these birds three severe and several milder cases of probable human psittacosis were derived. In this example we see birds infected in the nest, but apparently healthy, losing their resistance when placed under unnatural conditions. The virus spread throughout their tissues, much of it was excreted, and the birds became dangerous sources of human infection. Here the loss of equilibrium was due to changes in the host; in the human sphere the same type of process could be seen at work in the increased death rate from tuberculosis in the last war. The second breakdown of the equilibrium condition took the rather spectacular form of large-scale deaths of parrots in the bush. In 1938 dead parrots were observed in large numbers in some districts of South Australia; it was said that the birds almost disappeared in some places. In the same season deaths of wild parrots were reported in Victoria and near Launceston in Tasmania. From each State one or more recently dead birds were shown to have died from acute psittacosis. Any interpretation of an occurrence of this sort must naturally be rather speculative. The most likely explanation is that it resulted from a combination of two factors: (i) the accumulation of an unusually large proportion of birds, which had not been infected in the nest and hence had no acquired immunity, and (ii) the appearance of an abnormally virulent strain of virus. Most disease-producing microorganisms are rather labile in their virulence; changes occur usually in the direction of lower, but sometimes of higher virulence. Strains of lower than standard virulence will soon tend to disappear; those of higher virulence will have a temporary success, but they will have a greatly diminished chance of ultimate survival. A dead parrot will never pass on its infection to other birds. So there will be ups and downs of virulence, manifested sometimes by widespread deaths, at other times by an increase in the proportion of uninfected birds; but throughout there will tend to be a selective survival of those strains of virus which have what has been called standard virulence.

My second example is a virus disease which affects 80% or 90% of the human race, but usually produces no more serious symptom than an occasional crop of little blisters on the lip. The virus of simple herpes is easily isolated from these blisters, and once isolated it is a particularly convenient virus to study. Despite this, the natural history of the disease was obscure until recently. The regularity with which a crop of herpes blisters could be produced by a cold or an attack of some fever made some bacteriologists think that the virus was not an independent microorganism, but some extraordinary substance produced by the cells themselves. We now know that herpes is just as typical a virus infection as any other and that the herpes virus is derived only from preexistent herpes virus. Primary infection usually takes place between the ages of one and three years and is manifested by blisters in the mouth and sometimes on the lips and cheeks—aphthous stomatitis it is called in the text-books. If the child avoids infection at this period he develops an increasing resistance to natural infection probably associated with the thickening of the mouth epithelium with age, and only in exceptional circumstances does he become infected after the age of five years. The infected child soon recovers from his initial attack; but the virus is not eliminated. It lodges in some of the cells near the regions of primary infection and there lies latent until some stimulus like a cold calls it into activity. Then blisters containing much virus develop, and from these infective material is liberated, which can infect a susceptible infant. As far as one could determine, a person once infected carries the living virus in his cells till death. So it happens that we can divide all human beings into two sharply distinct classes: those who have never been infected with herpes and those who have been and still are infected with the virus. There is a simple means of testing the blood to determine whether anyone has herpes or not, and in the course of such tests an interesting sociological fact was uncovered. Amongst more than 100 public hospital patients, both adults and children, nearly 95% had been infected with herpes; in a group of 55 university graduates and undergraduates only 22 (40%) gave the positive result to the test which indicates herpes infection. It would make an interesting study to sort out the reasons for this difference according to social level; but I am more concerned with the 95% of infections amongst hospital patients. Here is a virus which has succeeded in infecting a large majority of human beings, which persists indefinitely in its host and at irregular intervals finds an opportunity of infecting fresh hosts. Biologically the herpes virus is the most successful of all the viruses which can attack human tissues. Before I leave the subject of herpes it may be of interest to note that the condition was probably as common in Elizabethan times as it is now, if one can judge from a reference to it by Shakespeare in "Romeo and Juliet". The quotation is from Mercutio's speech about Queen Mab, who drives

> O'er ladies' lips who straight on kisses dream
> Which oft the angry Mab with blisters plagues,
> Because their breaths with sweetmeats tainted are.

These two examples represent the most usual end-results of long-continued interaction between host and parasite. It must be recognized, however, that such mutual adjustment is a long process and will not necessarily hold if the microorganism finds an opportunity of infecting another species. The psittacosis virus from an apparently healthy parrot may produce fatal infection in man or in experimentally inoculated mice. The herpes virus from a harmless blister on the lip, if placed on a rabbit's eye, will often produce a violent inflammation, followed by spread to the brain and fatal encephalitis. Perhaps the most uniformly fatal of all infectious diseases is Rocky Mountain spotted fever. In Nature this is a disease of small rodents and their ticks, so mild that as far as I am aware no fatal infection in a wild rodent has ever been observed. When the germ is more or less accidentally transferred to an alien host, man, by a tick bite, the mortality rate is about 80%.

I hope that this discussion of two diseases will provide a sufficient indication of the general nature of the biological approach to the problems of infectious disease. The same point of view can be applied to any other infectious disease; the technical details will vary enormously from one disease to another, but in all the chief key to an understanding of the natural history of disease is a knowledge of the ways by which the parasitic microorganism manages to survive from generation to generation.

Conclusions.

I began this lecture by claiming that the germ theory of disease as formulated by Koch had been gradually superseded by a new outlook, which was sufficiently different to rank as a fourth major approach to the problem. Perhaps I may conclude with an attempt to summarize briefly what are the chief characteristics of this approach by which it differs from the old, and to indicate a few of its practical implications.

First, the idea of a single specific microorganism for each infectious disease has become much less distinct. All living organisms show variations around a standard form, and in microorganisms variation seems to be more readily induced and of wider range than in larger forms. There are bacterial species which in different circumstances may adopt either parasitic or non-parasitic modes of life, and even amongst the strictest parasites, the viruses, different strains of the same species may vary enormously in virulence. Such variability is probably an absolute essential for the survival of the species. I have indicated how readily minor changes in host or environment may so modify the result of infection that parasites of what we normally regard as standard virulence may become either too virulent or not virulent enough to ensure survival. Only a wide range of variability will provide a means of overcoming this difficulty. So we find that instead of one cause of pneumonia we have thirty different types of pneumococcus, and that even the bacillus of typhoid fever may take any one of a dozen different forms, while amongst influenza virus strains we find two or three major and many minor differences.

The second great difference from the theory of the 1880's is in the interpretation of the medically typical case of infectious disease. Instead of regarding a severe attack of diphtheria as the typical manifestation of infection with the bacillus, we are now much more inclined to consider it as a rare occurrence representing one of the extremes in the range of possible interactions between the two species. The standard behaviour of the diphtheria bacillus by which the species survives is to pass from throat to throat without obvious symptoms. Only in a few diseases, like measles and mumps, is the medically typical attack the dominant process by which the parasite survives.

From the practical standpoint of public health the biological approach leads to some important principles. In the first place, any severe outbreak of infectious disease will almost always be found to result from some gross disturbance of normal ecological relationships. A microorganism may be introduced into a population that has never come into previous contact with it, as was the case with several European diseases when they reached the Pacific islands. A similar intensity of infection may result when man intrudes into a host-parasite association that is, as it were, no concern of his. Most often such parasites will completely fail to infect the foreign host, but not infrequently they produce far more severe symptoms in the accidentally infected host than in the species with which they have evolved. I have already mentioned the examples of Rocky Mountain spotted fever and psittacosis.

Much more important is the effect of severe disturbance within the normal environment of a community on the balance between health and disease. Of all such disturbances war is much the most potent. With the calling up of recruits, camp infections of one sort or another arise, chiefly owing to the abnormally great opportunities for infection, but also influenced by the large numbers of "unsalted" recruits from the country. Meningitis is the most typical of these camp infections. On a much larger scale there is evidence that the development of the great influenza pandemic of 1918-1919 was a direct or almost direct consequence of war conditions in Europe.

When under the influence of defeat and revolution civilized life breaks down completely, infectious disease inevitably appears. In the period from 1917 to 1920 it is probable that not less than 20,000,000 people died of infectious disease in Russia, typhus, dysentery and influenza being the main causes of mortality.

This leads us to a second important principle, that it is futile to try to eliminate a given disease unless we can ensure that conditions will never allow its return to the community. We can and do try to eliminate typhoid fever completely, because we feel that we shall always be able to apply the sanitary measures necessary to avoid it. The diseases spread by droplet infection from person to person are in a different category. A wealthy nation at peace could, I think, use present knowledge to eliminate tuberculosis completely from its population within twenty years. But I should have the gravest misgivings in supporting any such policy. After one or two generations the nation would almost certainly suffer heavily if the disease were reintroduced at a time of economic disturbance. The complete extermination of any microorganism of disease will be prodigiously difficult, and could only be even dreamt of if world-wide cooperation in the attempt were available. To remember once again that every existing species of microorganism has found a way to survive the vicissitudes of 1,000 million years of existence will perhaps reduce any optimism about eliminating yellow fever or tuberculosis in a decade or two.

So one must end on a note of pessimism. At the present time it must sound merely ironical to speculate on how infectious disease might be almost automatically reduced to a relatively minor cause of death throughout a peaceful and prosperous world. In the immediate future hard thought and the application of all the resources of science will certainly be needed to maintain even our present standards of freedom from infectious disease.

DOSAGE INTERVAL IN SULPHAPYRIDINE ADMINISTRATION.

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THE current practice is to give sulphapyridine in frequent small doses, usually every four hours. The results here recorded show that equivalent blood concentrations and as satisfactory results can be obtained by doses spaced at much longer intervals. The interval of four hours adopted on the introduction of sulphanilamide into human medicine was the result of experimental work on small animals, chiefly mice and guinea-pigs, in which it was shown that only by frequent dosage could an adequate blood concentration be maintained. The possibility that rates of excretion, absorption and destruction of sulphapyridine and allied drugs might differ in mice and men was not considered, probably because there is no great objection in civil medicine to frequent dosage. The incentive to this study was the fact that in the field difficulty has been experienced by medical officers in ensuring frequent dosage for patients in transit from forward areas. In a large proportion of cases the accepted schemes of dosage proved impracticable. Since in the horse oral doses of sulphanilamide given once a day produce an even higher average blood concentration than the same total dose given at shorter intervals,[1] it seemed worth while to explore in man the possibilities of doses given at intervals of twelve and twenty-four hours.

Selection of Test Subjects.

Only patients with minor illnesses were used (Table I), for three reasons: (i) because it was desired to limit the duration of the course to three days; (ii) because vomiting is commoner in patients who are seriously ill; and (iii) to avoid subjecting sick patients to repeated venipuncture.

Dosage of Test Subjects.

The standard dosage employed was nine grammes of sulphapyridine on the first day, six grammes on the second and four grammes on the third day. This dosage was used without any adjustment for body weight, for the following reasons. Cullen and Wilson[2] have shown that individual variations in the blood concentration of sulphapyridine are pronounced even if a standard dosage per unit of body weight is employed. Further, the patients, mostly from Libya, were unable on their admission to hospital, to estimate their weights with any degree of accuracy, since most of them had lost from 14 to 28 pounds during a strenuous desert campaign. The patients were weighed during convalescence and their weights are shown in Table I. The tablets were ground to a fine powder and given in milk.

TABLE I.

Case Number.	Name.	Approximate Weight. (Pounds.)	Clinical Condition.	Dosage Interval. (Hours.)	Remarks.
I	Pte. Bk.	140	Pneumonitis.	4	No vomiting, nausea slight.
II	Sgt. By.	170	(Voluntary subject.)	4	No vomiting, nausea throughout.
III	Pte. Wr.	140	Phlebitis.	4	No vomiting, nausea slight.
IV	L.-Cpl. Bd.	140	*Bacillus coli* epididymo-orchitis.	12	No vomiting, nausea slight.
V	Pte. Fk.	150	Bronchitis.	12	Vomited once 1½ hours after second dose, nausea throughout.
VI	Gnr. Dn.	170	Streptococcal dermatitis.	24	No vomiting, nausea slight.
VII	Pte. Gh.	130	Streptococcal dermatitis.	24	Vomited 12 and 22 hours after first dose and 2½ and 3½ hours after second dose.
VIII	A.C.1 Bn.	150	Streptococcal dermatitis.	24	No vomiting, nausea slight.
IX	Bdr. Py.	140	Tonsillitis.	24	No vomiting, nausea slight.

Clinical Methods.

The method of Werner,[3] as modified by Fantl,[4] was used for the estimation of free sulphapyridine in the serum. Fantl found in four patients that the concentration was slightly higher in serum than in whole blood.

In a few samples no gross differences were found between serum and whole blood values, provided that the erythrocytes were laked prior to precipitation with trichloracetic acid. In these experiments oxalated blood was used, whereas Fantl used defibrinated blood. When the first estimations were made, no pure sulphapyridine was available. A sulphanilamide standard was used and the results were converted into sulphapyridine by a factor (1·4) based on the respective molecular weights of sulphanilamide and sulphapyridine. Checks with a sample of pure sulphapyridine received later showed that this factor was correct within the limits of experimental error.

Results.

The results recorded in Tables II, III and IV, and graphically in Figures I, II and III, show that equally satisfactory serum sulphapyridine concentrations are maintained by equivalent dosage at intervals of four, twelve or twenty-four hours. There is a pronounced individual variation in the serum concentration levels, which is not correlated with body weight. Thus Sergeant By. (Figure I), although 30 pounds heavier than Private Wr. (Figure I), attained much higher blood concentrations. It is true that there is less fluctuation in the blood concentrations on a four-hourly dosage; but the minimum concentrations are quite satisfactory with the longer dosage intervals. Individual variations in blood levels following identical doses are so pronounced that it is impossible to state whether higher average levels are attained by one scheme of dosage rather than by another. It happens that of those patients given the drug at intervals of four hours, two responded well and one rather poorly. Those given the drug every twelve hours all attained satisfactory, if not high, levels. Two of those given the drug at intervals of twenty-four hours reached high levels, and one reached

TABLE II.

Serum Sulphapyridine Levels Following Administration at Intervals of Four Hours.

Day of Therapy.	Time in Hours.	Dose in Grammes.	Serum Concentrations. (Milligrammes *per centum.*)		
			Pte. Wr.	Pte. Bk.	Sgt. By.
First	0000	1·5	Nil	Nil	Nil
	0400	1·5	4·1	4·2	—
	0800	1·5	5·7	6·0	5·4
	1200	1·5	5·7	7·0	—
	1600	1·5	6·1	8·9	7·4
	2000	1·5	6·7	8·9	—
Second	2400	1·0	7·0	8·9	9·9
	0400	1·0	7·0	9·4	—
	0800	1·0	7·0	11·3	10·5
	1200	1·0	7·0	13·1	—
	1600	1·0	7·0	11·1	11·1
	2000	1·0	7·3	10·2	—
Third	2400	0·66	5·2	11·3	11·9
	0400	0·66	5·2	12·7	—
	0800	0·66	5·2	11·6	11·6
	1200	0·66	4·6	11·6	—
	1600	0·66	4·2	11·4	11·6
	2000	0·66	3·9	11·3	—
	2400	—	2·9	11·3	11·6
Fourth	2400	—	0·7	4·9	9·2
Fifth	2400	—	0·3	2·0	2·3

TABLE III.

Serum Sulphapyridine Concentrations Following Administration at Intervals of Twelve Hours.

Day of Therapy.	Time in Hours.	Dose in Grammes.	Serum Concentrations. (Milligrammes *per centum.*)		
			Pte. Fk.	Gnr. Dn.	L.-Cpl. Bd.
First	0000	4·5	—	—	—
	0200	—	4·2	3·2	2·8
	0600	—	5·9	4·6	5·2
	1200	4·5	x[1]	4·9	8·0
	1400	—	7·3	5·7	8·3
	1800	—	x	5·7	8·3
Second	2400	3·0	5·5	4·6	6·7
	0200	—	7·1	6·2	5·9
	0600	—	8·0	6·4	7·6
	1200	3·0	5·5	5·7	5·6
	1400	—	6·0	4·6	7·8
	1800	—	5·7	4·6	8·0
Third	2400	2·0	5·5	4·9	4·3
	0200	—	7·7	5·3	x
	0600	—	6·7	5·3	x
	1200	2·0	5·5	5·6	3·5
	1400	—	x	4·9	x
	1800	—	5·7	3·6	x
Fourth	2400	—	4·6	3·2	3·1
Fifth	2400	—	x	2·1	2·5
	1200	—	4·2	x	x

[1] x denotes sample not taken.

TABLE IV.

Serum Sulphapyridine Levels Following Administration at Intervals of Twenty-four Hours.

Day of Therapy.	Time in Hours.	Dose in Grammes.	Serum Concentrations. (Milligrammes *per centum.*)		
			Pte. Gh.	A.C.1 Bn.	Bdr. Py.
First	0000	9·0	—	—	—
	0600	—	10·8	9·8	5·2
	1200	—	9·9	9·5	4·7
Second	2400	6·0	8·5	7·0	3·8
	0600	—	11·6	9·9	5·7
	1200	—	10·5	9·5	5·7
Third	2400	4·0	7·4	7·8	3·3
	0600	—	13·0	12·3	5·9
	1200	—	11·0	8·1	4·6
Fourth ..	2400	—	6·6	7·2	2·2
Fifth	2400	—	2·0	4·6	1·4
	2400	—	1·5	2·6	0·8

satisfactory but lower concentrations. It is at least likely that in a larger series, in which it would be possible to take an average of the results, no great difference would be shown between any of the methods of dosage. It seems that the four-gramme dose given on the third day is barely a sufficient maintenance dose for the average adult male, since, irrespective of dosage interval, the average concentration in the blood tended to fall to an inadequate level in some patients on that dosage, though not in all. When longer dosage intervals are employed there is a prompter immediate rise to a satisfactory blood concentration consequent on the larger initial dose. In most subjects there is an appreciable concentration in the blood twenty-four and even forty-eight hours after the last dose has been given. Evidently sulphapyridine is excreted more slowly than is generally recognized.

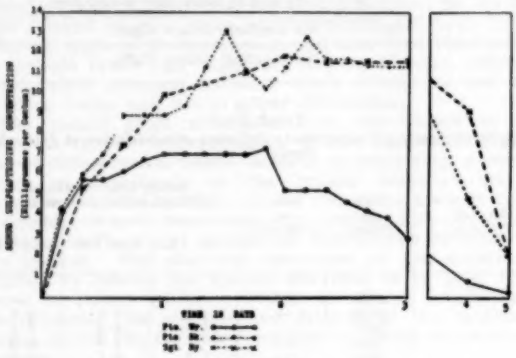

FIGURE I.
Serum concentration of sulphapyridine following administration of standard dose every four hours (see text) over a three-day period.

Clinical Observations.

The above results show that adequate blood concentrations of sulphapyridine can be obtained irrespective of dosage interval. It remains to record some clinical experiences with twelve and twenty-four hour intervals. Nine patients have been carefully observed on doses of sulphapyridine given every twenty-four hours extending over three to six days, including two suffering from meningococcal meningitis and one from post-operative

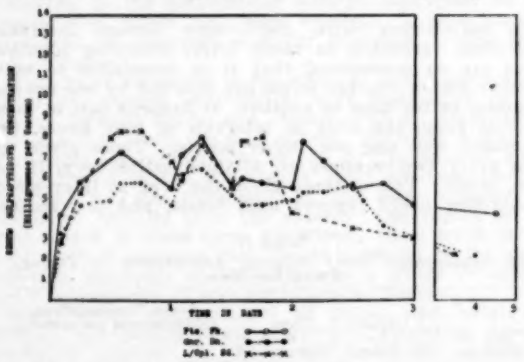

FIGURE II.
Serum concentration of sulphapyridine following administration of standard dose every twelve hours (see text) over a three-day period.

pneumonia. The average total dosage was 23 grammes, the initial dose varying from eight to ten grammes. Satisfactory blood concentrations were attained. Four of the nine patients vomited. In no case was vomiting serious or persistent, and in only one case was it necessary to repeat the dose. When vomiting did occur, it was at an interval of from three to twenty-four hours after the dose, and was precipitant, suggesting a central origin. Five patients treated with sulphapyridine at intervals of twelve hours appeared to react similarly to those whose dosage intervals were shorter. Only one vomited, and he only once. It has not been possible to compare the incidence of vomiting in a large series of patients given sulphapyridine at intervals of four, twelve and twenty-four hours, because sufficient patients requiring sulphapyridine therapy have not presented themselves and, for reasons of economy, only such patients have been given the drug. But it is an impression, based on recollection of its frequency among previous patients given the drug every four hours, that vomiting is not more frequent when the larger doses at longer intervals are used. No toxic effects other than nausea or vomiting were noted among the patients treated.

Major I. J. Wood and Captain Freemantle have kindly given me access to records of patients under their care who have been treated with sulphapyridine and sulphanilamide at intervals of twelve hours, with satisfactory therapeutic results. Forty-five patients were given sulphanilamide. These were practically all treated for streptococcal infections of the skin, local applications of powdered sulphanilamide being used in conjunction with oral therapy. The average dose per patient was 30 grammes; the average duration of the course was five and a half days. A typical course consisted of the following doses on consecutive days: 10, 5, 5, 4, 3, 3 grammes. Four of the 45 patients vomited, two of them once, one twice, and one four times. The average total dosage in these four cases was 32 grammes; this did not differ significantly from the average total dosage in the whole group. Ten patients of the group exhibited a rash. The average total dose in these

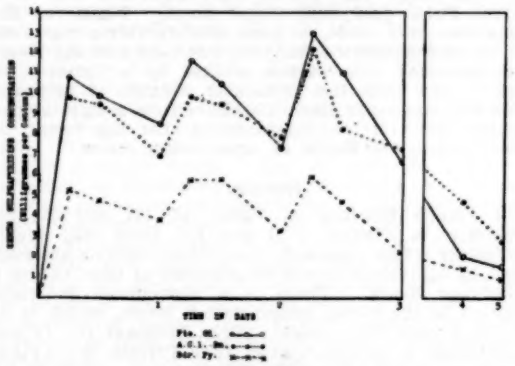

FIGURE III.
Serum concentration of sulphapyridine following administration of standard dose every twenty-four hours (see text) over a three-day period.

10 cases was 28 grammes. Fifteen patients, none of whom was seriously ill, were treated with sulphapyridine at intervals of twelve hours. The average total dose was 29 grammes given over an average of four and half days. The typical course was 10, 8, 6 and 4 grammes on successive days. Four patients vomited, two once and two twice.

Discussion.

No great advantage other than convenience is likely to be gained in civilian practice by the use of longer dose intervals; but certain considerations warrant their use in military medicine, both in the field and in base areas.

The disadvantages of short-interval dosage in prophylactic treatment have already been indicated. The twelve-hourly treatment interval would usually overcome the difficulties experienced in continuous administration of the drug during evacuation of casualties. An interval longer than twelve hours is unlikely between the field ambulance, where the dose should be given, and the casualty clearing station, where it can be repeated. If greater distances are to be covered, then doses can be given every twenty-four hours. For prophylaxis five-gramme doses are recommended, to maintain blood concentrations of two or three milligrammes *per centum*. This dose should be given as soon as possible after the soldier has been wounded. This

five-gramme prophylactic dose was given to Australian Imperial Force casualties in the Syrian campaign. It is small compared with the nine-gramme doses which have been given without ill effects to many patients. For patients in casualty clearing stations and in base hospitals, or in civil practice, the dose interval of twelve hours is the most convenient. The psychological factor in vomiting is not inconsiderable, and the patient is happier if not assaulted at frequent intervals with the drug he blames for his nausea. There is less work and anxiety for the nursing staff, who are not perpetually worried by doses ordered to be given every four or six hours. The patient is not wakened more often than once in the night; in fact, in most cases it is easy to arrange the scheme of dosage for the night to be undisturbed. Although nausea and vomiting occur as frequently as when shorter intervals are used, there are usually one or two periods in the day, just before the dose is due, when the patient has a reasonable appetite.

The objection has been raised that if the patient vomits after a large dose the physician is in doubt whether to repeat the dose or whether to give more drug intravenously or intramuscularly. Vomiting does not occur, unless exceptionally, until the drug has left the stomach. This is to be expected if vomiting is of central origin and associated with a high concentration of sulphapyridine in the blood, which cannot occur until the drug has been absorbed. Examinations of the vomitus in a few cases revealed only traces of sulphapyridine. It is recommended that the full dose should be repeated if the patient vomits immediately; that half the dose should be repeated should he vomit within fifteen to thirty minutes; and that no further dose is necessary if the interval is greater than half an hour.

Finally, the more rapid rise of concentration of the drug in the blood, consequent on the larger initial dose, is an advantage in fulminating infections. These results confirm the difficulties of forecasting what blood concentrations will be attained in an individual instance with any dosage scheme. For that reason it is desirable, where facilities exist, to carry out daily estimations of the blood sulphapyridine concentration until the required level is reached. This is a simple laboratory procedure, provided a colorimeter is available.

Suggested Schemes of Dosage.

The important factor in successful sulphapyridine therapy is the maintenance of an adequate concentration of the drug in the blood and tissues for a sufficient period. The average adult male requires an initial dose of eight to ten grammes, and maintenance doses of four to six grammes per day. The daily totals can be divided into smaller doses and given at any interval which is convenient.

My own practice is to give the patient an initial dose of four or five grammes, followed by doses of three grammes, all at intervals of twelve hours. For prophylaxis in the field an initial dose of five grammes is recommended within twelve to twenty-four hours; it can then be decided whether to continue with small prophylactic doses or to proceed with full therapeutic doses.

Summary.

1. Three groups of patients were studied who were given nine, six and four grammes of sulphapyridine on successive days, at dosage intervals of four, twelve and twenty-four hours.

2. Approximately equivalent concentrations of sulphapyridine in the blood were obtained in the three groups.

3. Administration every twelve or twenty-four hours is practicable for immediate prophylactic use and during the evacuation of casualties. Dosage every twelve hours has advantages in military hospitals and in civil practice.

Acknowledgements.

This paper is published by permission of the Director-General of Medical Services. I wish to thank Major E. V. Keogh for his encouragement and help, and Miss Mavis Freeman, B.Sc., for the biochemical estimations.

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INSTINCTS AND THE HERD.

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Instinct.

SINCE instincts provide the motive force for all animal activity, they merit the consideration of those who must cope with the vagaries of human behaviour. Unfortunately, there is much uncertainty as to what constitutes an instinct, and much difference of opinion as to how many instincts there are. Woodworth,(1) indeed, would abandon the term "instinct" as unnecessarily productive of confusion, and proposes instead such titles as "unlearned reaction" or "unlearned response". However, used in its original sense as an inborn, purposive but unlearned activity, the term instinct need give rise to no confusion; this comes only from poor distinction of learned from unlearned.

The number of instincts determined by different psychologists differs fairly widely: McDougall(2) finds fourteen, Woodworth(1) about eight, Trotter(3) only four. Although examples might be multiplied, these serve to illustrate the range offered. But however elaborate the lists so drawn, and however they differ in detail, they are all unanimous in including two—self-preservation and reproduction; or more briefly, self and sex. This is of particular interest to the biologist whose observations on animal activity fail to disclose with certainty more than these two; and there are not wanting a few psychologists to maintain that no more can be detected in human behaviour. In fact, it needs but little thought to reduce the longest list of "instincts", and the plethora of emotions cited in relation to them, to terms of self and sex, in spite of Woodworth's assertion that such simplification is wrong. It would appear that this author has fallen into the trap against which he expressly warns his readers—namely, confusion of learned with unlearned reactions.

In 1908 Wilfred Trotter added to the list what he called the "herd instinct". Impressed with the energy with which humans conduct their social affairs, he insisted that such force could come only from instinctive urge. In the years following until 1919 he collected a great mass of observation and reflexion, wrought into a well-knit and logical system. This system, moreover, withstood the major sociological experiment of the war of 1914-1918. While Trotter's observations on that war are of particular interest, their consideration must be deferred; this paper is concerned mainly with the basis and general application of his views.

The "Herd Instinct".

Certain that the force behind social activity is instinctive in origin, Trotter sought a criterion by which to recognize instinctive behaviour, no matter how disguised. The criterion he accepted was the *selbstverständlich* principle—the *a priori* synthesis of William James.(4) According to this, what is the obvious thing to do, what

activity admits of no question in the mind of the performer, is instinctive. It is clear that "the obvious thing to do" is the theme which pervades our whole social system, and Trotter felt that here was the touchstone he sought. Thus he assumed that there is an instinct which causes men, and some—but not all—animals, to associate; this is the gregarious or herd instinct. But Trotter was not wholly uncritical of James's definition. He saw that in some matters what is the "obvious thing" to one person is not so to others, and this applies particularly to questions of religion, justice, honour *et cetera*. Is there, for example, one instinct to make some people Roman Catholics and another to make others Protestants? It is scarcely conceivable; but the emotional force aroused on behalf of either belief is undeniable. In his doubts Trotter held the key to his problems; but the true explanation was then only emerging obscurely from the laboratory, and when later it became world famous he failed to recognize it. So, having entered his *caveat*, as it were, he proceeded to his observations. Here it is only right to add that Trotter did not claim for his "herd instinct" the force and importance of the self-preservative and reproductive instincts; at best it was only secondary to these. Briefly, Trotter's views are as follows:

Humans have an instinct for collecting in groups; it is this "herd instinct" which supplies the motive force behind social behaviour. The group devises a code to regulate the conduct of its members; thus arises a "group mind" which functions as censor of activity within the group. Saturated early with the teachings of the "group mind", the individual knows whether or not his behaviour is in accord with the wishes of the majority. Overt conformity brings reward and satisfaction; non-conformity brings punishment, and the dissatisfaction and loneliness engendered by isolation from the "group mind". In addition, each individual carries within a reflexion of the code he has learnt; this inward criterion is the conscience (censor or super-ego). Thus even covert thought or action does not escape criticism: if it implies conformity with herd ideals the feeling of unity with the herd brings a glow of (righteous) satisfaction; if it implies non-conformity there are mental isolation and dissatisfaction—a sense of guilt.

While the herd is small and compact its teaching is readily appreciated and diffused, and disobedience is easily punished. As the group prospers and expands the central influence wanes, and subgroups, often at variance, arise. With the passage of time the original code of conduct becomes—in part at least—out of date, and often contrary to the teachings of everyday observation and experience. Thus the code becomes more and more arbitrary and irrational—at the least an irritating anomaly, at the worst a positive menace to social security. Nevertheless, those who administer the law, owing their position and security to its observance, insist upon obedience in every arbitrary particular. Younger members chafe at the anomalies and sense the dangers, and as time discloses an ever-widening breach between precept and fact the ranks of the rebels swell. But only the strongest can effect even minor reforms, the awful bulk of the law remains, and the rebels are frustrated. In this manner the successful society comes to comprise two major elements: the "stable" class, which constitutes the "backbone" of the community and exacts every social observance, and the "unstable", who have the intelligence to appreciate the necessity for reform but lack the power to act. Both classes menace security: the "stable" direct policy ignorant of the danger they court from blindness to reality; the "unstable" refuse to support a system to which they cannot give intellectual approval. Moreover, the "unstable", frustrated, often seek escape in drugs, vice or neurosis, and further endanger social security.

In 1909 Trotter saw in these conflicting elements the source of imperial decay in the past, and he foretold disaster unless the "stable" combined with the intelligent and receptive "unstable" to reform national policy. Within five years the disaster befell; and after a further twenty years of uneasy rule by the same "stable" class it has befallen again. In a quarter of a century Trotter witnessed double proof of the truth of his reasoning, for he died only in November, 1939.

While this brief summary provides ample support for the justness of Trotter's conclusions, it pays scant tribute to the wealth of observation upon which those conclusions are based. Nevertheless, it will suffice for the ensuing discussion. This takes the point of view that however accurate Trotter's observations may be, and however just his conclusions, the major premiss is faulty—that there is no "herd instinct", and that social behaviour comprises a series of conditioned reflexes—more accurately, conditioned responses.

Trotter assumes freely an inborn tendency for humans to congregate. This appears obvious from observations upon social communities; but what is the evidence that gregariousness is inborn and unlearned? In any community a child is born into an organization already in being, learns group lore at its mother's knee and—knowing naught else—considers the group its natural environment, separation from which engenders fear, expressed as loneliness. Observations upon children born into communities give no clue to the mental activities of those born outside; but even within the community children, until they "learn better", are notoriously egocentric and anti-social. It is no argument to assert that, like the sexual instinct, the "herd instinct" will mature later; the sexual instinct will inevitably manifest itself in any environment provided the organs of generation are healthy, whereas there is no evidence that a social tendency will necessarily appear at any age.

Modern anthropological opinion assumes that the primary social unit is the horde, and that within this have distilled out, as it were, the various sub-organizations, such as families, which characterize more civilized communities. This would appear to support Trotter's view that herding is instinctive, but for the coexistence of non-social peoples. The Australian aboriginal provides examples of both types of organization. Baldwin Spencer[6] has described in detail the social blacks with their elaborate codes; his account of solitary straggling families eking a miserable existence in the arid plains of Western Australia affords a striking contrast. These solitary blacks may be considered either as in a pre-social state or as degenerated remnants of a former society. But neither view supports Trotter's assumption of an original herding "instinct". If the state is pre-social the instinct is denied, and degeneration can be only to a more primitive condition. Herding, if instinctive, should eliminate all possibility of the solitary state.

Further, the self-preservative and reproductive instincts find practical expression each in a manner virtually the same throughout the human race. On the other hand, manifestations of the gregarious tendency differ with practically every different group. Why, for example, should the German lust after world domination, the Englishman after peace and freedom? Why should the Arab embrace the warlike tenets of Islam, the Buddhist the serenity of Nirvana and the European the peaceful precepts of Christianity? Or, given an inborn tendency to religion, why should there be so many "jarring sects" in each, and so few real worshippers?

So the tale might continue; but enough has been said—there are too many whys. The manifestations of the social tendency are too various all to be included within the scope of a single "herd instinct". Pushed to its logical extreme, this conception breaks down completely, and ultimately explains nothing. If, however, the idea of an all-embracing instinct is abandoned, and social conduct is viewed as a series of conditioned responses, the whole problem falls readily to solution. On this reasoning the argument runs somewhat as follows.

The Herd Response.

People associate primarily for protection against forces with which they cannot cope individually and, up to a point, the larger the group the greater the protection. One or more men with ability above the average take the lead and, to enhance group efficiency, devise rules for internal conduct. The first rule would certainly enjoin obedience to the leader; then, to promote social harmony,

there would be injunctions against theft in its widest sense and murder. (It is noteworthy that the injunctions against theft and murder apply only within the group; exceptionally are they extended to neighbouring groups in return for similar concessions.) Obedience to authority and suppression of theft and murder are the minimal essentials to group security; they form the basis of any legal code and may be referred to as "primary laws".

Upon this basis arose a superstructure of law, sanction and tradition which, however intelligible at the time, became in later practice arbitrary and irrational. These are "secondary laws". Elliot Smith[6] has traced the origin of the factors responsible for the development of some of these secondary laws, and the evidence is summarized elsewhere (Abbie[7]).

Briefly, outstanding rulers were deified and thus credited with immortality. This distinction was later extended to royal descendants and other minor leaders. Finally, after a much longer interval, the masses received the rights of immortality. So there came three classes. The king was above all—a god. His descendants and other rulers were lesser gods. The two groups together formed a relatively small but powerful coterie which enjoyed special sanctions ensured by a private code—a "privi-lege-d" class. The masses enter into some of these advantages only late in history, and grudgingly; they never overtake the leaders whose privileges set them apart and secure ruling power. Thus class distinction and the system of religion have a common basis. And since the privileged classes have not infrequently used their religious sanction to further their temporal interests reform was hard to achieve. Even today the conception of the divinity of kings and the rights of the privileged classes dies hard in Europe; in the past it was particularly strong, as the following seventeenth century passage (attributed to Shakespeare) from the play "Sir Thomas More" reveals:

> for to the king god hath his offyce lent
> of dread of iustyce, power and comaund
> hath bid him rule, and willd you to obay
> and to add ampler maiestie to this
> he hath not only lent the king his figure
> his throne and sword, but gyven him his owne name
> calls him a god on earth, . . .

Similarly, this theme pervades "The Maid's Tragedy", a play by Beaumont and Fletcher and many others of about the same period.

A system of religion demands an interpreter. The first was the king himself, but as he was engaged in temporal affairs he was glad to delegate progressively more of his authority to others, drawn at first from the privileged class, later from all classes. Thus arose a fourth entity, the priesthood, which, although drawn from all classes, assumed the sanctions formerly reserved to the king and nobility and similarly became privileged and set apart; usually some formal temporal sacrifice was exacted in return. Clearly, religion and social distinction are inseparably entwined; it is overwhelmingly with religion and social distinction that the secondary laws are concerned, and conceptions of religion and social distinction differ with every different group.

So it is that law comes to comprise two distinct elements: an essential basis recognized by every legal code and a secondary superstructure which differs from group to group. In time the two become so entangled that it is difficult to distinguish the substance from the shadow; but the secondary element, backed by the glitter and force of the privileged, and charged with the sanction of religion, comes to assume such imposing proportions that it quite overshadows the essential basis. Because this superstructure is so arbitrary and diverse the fight rages hottest around its details. Crimes against the primary law become minor affairs in comparison with a trifle of interpretation of the secondary; churchmen have not shrunk from murder over a point of religious difference, and a social solecism may demand an equally bloody expiation. It is over details of the superstructure, too, that racial differences arise—at the least underlining the principle that "the crimes of Clapham become chaste in Martaban", at the worst fomenting "holy" war over some difference of opinion. Nor when about to violate the primary law does the astute man fail to invoke the secondary, as exercising the greater popular appeal: *Gott* is always *mit uns*.

The individual finds obedience to herd dictates profitable, disobedience unprofitable, and soon "learns how to behave". When he is mature—self-preservation satisfied with a safe competence, and sex with marriage—he is firmly convinced of the merits of the system. In the law which he has learnt to obey he fails to distinguish the substance from the shadow; the whole system brings and ensures comfort and satisfaction, therefore the whole system is good and must be observed *in toto*. And since continuance of this security depends upon observance of the law by others, it is scarcely a matter for wonder that the leaders exact observance in every little particular. On the other hand, it is scarcely a matter for wonder that youth—economically unstable, sexually unsatisfied and oppressed by the injustice of the system—rebels. Today, with economic security and sexual satisfaction receding further from youth's grasp, is it any wonder that social unrest increases, or that divorce, prostitution and sexual aberration — not to mention escape into drugs, vice and neurosis—flourish? As Trotter clearly saw, the present system seems designed to swell the ranks of what are called the "unstable"; when those ranks become full enough there is trouble.

In truth it takes an exceptional man to modify the code in any particular, and only exceptional men have succeeded; but historical record is littered with the wrecks of those destroyed in the attempt. Every independent intellect must see the faults of the system; the system in turn misunderstands those who rebel when compliance would bring comfort and security, and labels the rebels mad. Trotter has truly said that ". . . the catchword associating insanity and genius tells us nothing about genius but a great deal about the situation into which it has had the misfortune to be born".

From the foregoing it is reasonably clear that gregariousness is not inborn and instinctive. Even the primary law, the minimal essential to communal security, must be constantly policed and enforced; the arbitrary and irrational secondary law remains a perpetual source of conflict. As has been mentioned previously, such conflict concerns chiefly matters of religion, justice, honour *et cetera*, and these are in dispute because they are arbitrarily determined by a religious and social system which has been quite arbitrarily evolved. It is not the customs, however, but the force with which belief in them is held that is so important; the strength of the belief betrays the instinctive urge. In these matters the strongest belief can be aroused in diametrically opposed views; both cannot be correct, neither is necessarily so, and either may be in direct contradiction to everyday observation and experience. Nevertheless, the disputant utters his proud *credo quia impossibile* and goes his way. More often still the fight rages over matters which are beyond all possibility of solution; they are articles of faith.

It is not hard to show that such beliefs are the result purely of education or conditioning. They reflect accurately the country, class or religion in which the holder has been brought up since his early days. They are all matters in which belief is enforced by example, reward or punishment, and constant reiteration. Thus it is that the German born and bred in Germany learns only Germany's destiny of world supremacy; brought up in an Australian environment, the German becomes indistinguishable from other Australians—indeed, he may fight as valiantly as these in defence of ideals quite contrary to those of his forebears. The man's heredity and inborn instincts are unchanged; he still strives for existence, and he marries, but different conditioning enlists his support for a different social standard.

The strength with which a belief is held depends partly upon the force with which it has been instilled, partly upon the time devoted to the process, partly upon the degree of association with others of similar belief and partly upon the comfort the belief brings. The persistence of any belief depends upon all these factors, particularly upon the constant reinforcement from association with those who think the same, and especially upon the extent to

which the belief continues to bring comfort. As Trotter has pointed out, beliefs are substitutes for reason; they provide a ready-made support in moments of stress, an equipment guaranteed to carry the holder comfortably through the most tiresome situation. Thus the wealthy believe the poor happier in their poverty, the poor consider the rich ridden with vice—and both derive comfort from the thought.

But the conditioning of youth can be undone; deconditioning is as readily effected in humans as in Pavlov's dogs.[8] Witness the "turned" Catholic, the "self-made" millionaire, the Vichy Frenchman, the reformed bully. Whatever determines the change—love, interest, environment or simply a sound thrashing—it is usually more than a mere reversal; the new belief is held with even greater tenacity than the old. None is more bigoted than he who changes his religion, none more snobbish than the *parvenu*, none more anti-British than the Vichist, none more zealous than the reformed. This excessive adherence to an opposing belief appears to depend upon the rationalization that if the new is strong enough to change the old, then obviously it must be so much the more worthy of support; this thought compensates for the cry of "turncoat" which may arise.

Social behaviour is, then, just a series of learned reactions evoked by promise of reward or threat of punishment, a series of conditioned responses which can be built up and broken down by environmental changes just as Pavlov conditioned his dogs to respond to various arbitrary stimuli—often painful or unpleasant ones—and as readily deconditioned them again. Social behaviour differs in different communities only according to the different ideals to which the individual has been taught to respond.

Here two questions, at least, will be asked: (i) If the gregarious tendency is not instinctive, how can it command emotional forces comparable with those aroused by instinct? (ii) If the secondary law is so diverse, arbitrary and irrational, how does it find such bitter defence? And why does it exercise so much greater power than the more important primary law? The answer to both questions is the same, and is implicit in what has gone before.

The Instinctive Basis of the Herd Response.

It must be fairly clear by now that the only force that could induce men to associate in comparative amity, and submit to a legal code which entails considerable personal sacrifice, would be that exercised by the necessity for survival. The community is an organism vastly greater in power than its individual members; it protects them from enemies, both internal and external, provides food where individual efforts would fail, and supplies comforts and advantages unattainable outside. All these considerations lead to one end only—self-preservation, and it is the self-preservative instinct which discounts the attendant discomforts in face of the one simple overriding necessity. Obviously, the protective function of the group is enhanced by internal harmony, hence the necessity for law; the primary law aims to eliminate internal danger and thus permit concentration against external danger. So far there can be little dispute, and it is clear that the group could function effectively with only the primary law as guide.

Deification of the ruler, however, and the conception of immortality, introduced new considerations. The primary law, after all, ensures only temporal security, and at best this is but temporary. How much more desirable is perpetual security—immortality! The desire for immortality is simply an extension of the self-preservative instinct; and as the prize is incomparably greater, so much the greater is the instinctive response. That is why law devised in the name of religion exercises so much the greater sway; that is why crimes against the primary law sink to insignificance in comparison with those against the secondary. Unfortunately, while the primary law is universally acknowledged, the secondary, devised in the interests of so many different conceptions of religion and class distinction, differs from community to community and often between subgroups within the community. In this way the fortified self-preservative instinct is aroused in defence of many different conceptions, and the fight is fiercest over matters beyond solution—over articles of faith usually traceable to conditioning at the mother's knee.

It may be assumed that the secondary law was consistent with the knowledge and belief of its era; yet when time disclosed the widening breach between law and fact, the secondary law survived. The reason for this, too, is found in the self-preservative instinct. The privileged enjoy such temporal advantage from the operation of the secondary law that reform urged by the self-preservative instinct of the masses evokes the strongest self-preservative reaction; and since the privileged control communal power reform comes slowly. Apart from the privileged class, however, every economically secure individual or group sees an economic threat in proposed amendment and reacts as fiercely. (Even the masses, whatever their justification, betray themselves, in power, as selfish and reactionary as the privileged; they lack only the education to react as gracefully—the beggar on horseback is no myth.) Further, to preserve its integrity each little group develops its own set of passsigns—dress, modes of pronunciation, use of eating implements, subjects for discussion *et cetera*—to detect intruders. The masses as a whole acquiesce; they have been conditioned to a certain set of beliefs, and after all, there may be something in them; in any case, the poor have more to hope for in immortality than have the privileged.

When the clamour for reform becomes too strong to ignore, it is usually countered by the threat that alteration of the secondary law will risk destruction of the primary law and with it the whole system. Here the appeal is to the self-preservative instinct—nobody wants to lose the system which protects and feeds him, and the outcome is generally continued submission. While such confusion of the primary and secondary laws is common, it is not necessarily wilful. The rich may really believe that legal amendment will entail social disintegration; such rationalization becomes easier in proportion to social status. On the other hand, confusion of the two aspects of law is a double-edged weapon. It serves the purpose of those with a stake in the system; those with nothing attribute their misery to the whole law. The obvious injustices of the secondary law bring the primary law into disrepute also; the miserable see no reason why they should obey the one more than the other—they have nothing to lose. If no definite argument can be raised against legal reform, it is usual to point out that the system has worked very well in the past, why alter it? "What was good enough for my grandfather and my father is good enough for me."

It is no contradiction of the self-preservative instinct that individuals have martyred themselves over matters pertaining to the secondary law. Since this is conceived primarily in the name of religion and immortality, they sacrifice what seems to be a temporary gain for a richer and more lasting prize, however nobly they suffer. It may be added that martyrdom was never a popular pastime; in all ages it has been rare enough to excite comment, forcing the regretful conclusion that when it comes to pitting the certainty of temporal extinction against the possibility of eternal life, the self-preservative instinct usually steps in and decides in terms of the certainty. And it is (perhaps unconsciously) in the interests of self-preservation that the child learns tribal lore at the mother's knee. Women have so much more to lose from social disintegration than have men—especially in primitive communities—that they take the greatest pains to instil every particle of law, however irrational, to ensure the maximum security.

The self-preservative instinct is reflected again in the nature of the appeals made to the community. These are nicely adjusted to the beliefs of the audience. In mediæval Europe the tremendous influence of the Church dictated an appeal along religious lines, and a whole

continent might be moved to a crusade in defence of the Holy Land. Then, the self-preservative instinct found its greatest hope in the belief in immortality and gladly made the sacrifice in the name of religion. Today, the religious appeal is weaker. Crusades still set forth; in democracies the prize is freedom (from persecution and death); in Axis countries the prize is still called freedom, but in this case from encirclement and economic death. In both cases the urge to action comes from the self-preservative instinct. Within the community the appeal may be either temporal or spiritual—the politician offers less work for more pay, the priest promises a brighter heaven or threatens a hotter hell; but it is always an appeal to some aspect of the self-preservative instinct.

The self-preservative instinct thus dictates the major part of social behaviour, it is the motive force behind acts both base and noble. Self-preservation pervades every social sphere: it sways the poor to revolt, the wealthy to react. Trotter was right, then, in ascribing social energy to instinctive force; he was wrong only in requiring a special instinct; self-preservation supplies the energy.

The Relation of Conditioned Responses to Instinct in General.

Since it appears that the mass of conditioned response known as social behaviour is based upon the self-preservative instinct, it is pertinent to inquire to what extent any conditioned response is related to instinct—either the self-preservative or the only other we know for certainty, the sexual. The only really controlled work on conditioned response that we have is that by Pavlov.[6] Here dogs learned to respond to various arbitrary stimuli by the production of saliva, the strength of response being measured by the number of drops produced. Thus the responses were based upon feeding reactions. Many psychologists have postulated a definite "nutrition instinct"; but how the taking of food, however elaborately disguised, can be dissociated from the simple necessity for keeping alive is far from clear. It would appear that feeding is just one aspect of the self-preservative instinct, and that the conditioned responses elicited by Pavlov derive their force from this instinct. It is of interest to note, too, that when some of the dogs were faced with conflict, as when presented with closely similar conditioning and deconditioning stimuli, they were unable to determine a definite course of response, and just as some humans do in like circumstances, they sought refuge in neurosis.

Is there any evidence that the sexual instinct has given rise to recognizable conditioned responses? Comparative biology provides innumerable examples of elaborate ceremonial associated with gratification of sexual urge; but it is uncertain to what extent these ceremonials are learned reactions or simply chain reflexes developed in the interests of the sexual instinct—in insects the ceremonial appears instinctive. Human behaviour presents a mass of detailed custom related to puberty, menstruation, courtship, betrothal, marriage and childbirth. These are all clearly learned, and not instinctive; but the fact that these customs have developed in communities makes it difficult to distinguish those dictated by herd response (that is, the self-preservative instinct) from those dependent purely upon sex.

It is not unreasonable to assume, however, that sexual ceremonial dictated by the herd is that which aims to preserve social integrity. In this category come restrictions on sexual licence (especially post-nuptial) which might lead to chaos in legal administration, demand for proofs of manhood before marriage to ensure healthy and well-protected offspring, obstruction to marriage "out of class" lest the comfortable order of the social structure be disturbed, and so on. And since most legal codes are masculine conceptions, there are ideas of masculine mastery over the wife or wives, definite restriction of feminine liberty, and insistence upon male succession. Excellent examples of most of these conceptions can be found amongst the Australian aborigines and in the legal code of the most civilized European nation. Thus sexual union which enjoys public approval is publicly celebrated in a series of definite and more or less elaborate ceremonies; unions contrary to public opinion, if discovered, are punished in various ways ranging from death to persecution or ostracism. The influence of herd teaching reaches to individuals, too; the maiden is taught to be coy and to demand proofs of sincerity, lest she be betrayed; the youth is taught to prove his manhood by pursuit, but to be wary lest he catch someone unworthy. There are, too, customs which relate purely to privilege, although today civilized nations repudiate them. Such were the right of the ruler to first choice of the women, the seignior's right to the *prima noce*, the divine right of the Ancient Pharaohs and the Royal Incas, alone among their people, to marriage with their sisters. Here it may be mentioned that modern ideas of the immorality of incest are traceable to the conception that this was a right reserved for the gods—that is, the Pharaohs.

In all the instances discussed the underlying urge is that of herd dictate, the aim is to safeguard the social structure—self-preservation in its widest conception, in other words. But the self-preservative motive is often more frankly expressed. The aborigine elders demand the young women in order to secure the most vigorous getters of food. In warlike communities the women prefer warriors who can protect them, the warriors in turn take the women with the richest possessions; today, the "successful" marriage is that which brings economic advantage of some sort or another. In all these cases at least one party to the contract is moved mainly by the self-preservative, not the sexual instinct.

Activities which tend to foster sexual gratification, especially in defiance of social opinion, might be considered as derived purely from the sexual instinct. Young people learn how to attract the attention of desirable members of the opposite sex, and how to avoid the notice of the socially rigid. Nods, winks, handkerchief-dropping, well-planned faints, the appropriate use of perfume, cosmetics and dress, are all learned reactions designed basically to further the interests of the sexual instinct. And there are many differences from nation to nation. For example, in cosmetics the European woman generally tries to enhance the work of Nature; but in other continents it is common to find a variety of schemes for doing precisely the opposite—according to European standards, at least. The Englishman might employ a languishing look, or even a nod or wink; but he would scarcely conceive of the Latin practice of serenading, still less of the Venetian custom of buttock-pinching, to disclose his infatuation to a member of the opposite sex. These are all quite arbitrary acts, obviously learnt, differing in different communities and not, apparently, related to the self-preservative instinct—often, indeed, they risk direct conflict with the self-preservative instinct. Should they, then, be classed as conditioned responses?

It was pointed out previously that it is not so much the custom as the force with which belief in the custom is held that reveals the instinctive urge. People will defend to the last beliefs in which they have been bred, and it has been shown that such defence comes ultimately from fear lest change endanger security—from the self-preservative instinct. Can it be said that any one of the customs apparently related solely to the sexual instinct is held with anything like comparable force? The answer is no. There are many approaches to sexual gratification, and as far as this alone is concerned it would be hard to find an individual to trust so strongly to any one as to risk his fate to it entirely. It is true that he may strongly believe marriage to be the only approach; but if so he is conforming to the herd ideal, communal self-preservation. And in truth, as long as they do no obvious violence to the social code, most of the "romantic" customs referred to above enjoy the playful tolerance of the community. It is only when the code is threatened that disapproval appears; the counter is "discretion"—the act is hidden in the interests of self-preservation. It would appear doubtful, then, whether any conditioned responses can rightly be regarded as arising solely from the sexual instinct.

Conclusion.

The evidence, as far as it goes, seems to indicate that social behaviour as a whole is really a series of conditioned responses, and that these derive their force from the self-preservative instinct. It is of interest that the influence of the social code appears to be mostly restrictive, and that these restrictions are directed against individual manifestations of the instincts of self and sex. Thus we have the massed self-preservative instinct of the whole community ranged against the individual self-preservative and sexual instincts, and the community usually wins, much as a band of warriors will vanquish a single combatant by force of numbers. This appears to be a sort of social "law of mass action". Society will tolerate no virtuosity in matters of self and sex; the social fabric might not withstand the strain.

It can readily be seen that mental conflict and social unrest come from rebellion, fed by the instincts of self and sex, against the total self-preservative instinct of the community. The cure is clearly an amendment which will permit the greatest, and certainly the most equal, individual satisfaction of these instincts within the limits of social security.[1] In other words, since the secondary law—devised in the interests of so many differing conceptions of religion and privilege—has failed miserably and repeatedly in its aims, it must be revised along the lines of an entirely new conception as to what is essential to social security. Some idea of the minimal essentials has already been given.

Summary.

1. Only the instincts of self-preservation and sex can be discerned with certainty in human behaviour.

2. There does not appear to be a "herd instinct" as such; herding is promoted by the self-preservative instinct, and social behaviour is a series of conditioned responses; the total reaction is best referred to as the "herd response".

3. The force behind the herd response comes from the self-preservative instinct; the workings of this can be traced quite readily in most social activities.

4. Social security demands a communal code; the essential part of this—the "primary law"—is universally accepted; the non-essential part—the "secondary law"—is developed mainly in the interests of different ideas on religion and privilege, and differs from community to community.

5. The secondary law is arbitrary and irrational, unjust in its application and a danger to social security; it survives partly by privilege and tradition, partly by supposed superhuman sanction.

6. Social disputes and national differences are mainly the outcome of the application of the secondary law.

7. Social security is endangered by the inequitable repression of individual manifestations of the self-preservative and sexual instincts.

8. Social security can be ensured only by legal amendment to permit the fullest possible individual satisfaction of these instincts.

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[1] I think that it was Gorki who said (approximately): "Can't you see that all a man needs is a loaf of bread and a woman?"

THE PERMANENT IMPLANTATION OF GOLD RADON SEEDS: THE TECHNIQUE AND INDICATIONS FOR THE USE OF THE METHOD.

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INTERSTITIAL radium therapy, or the introduction into the body tissues of radium in containers, has been in use now for many years, and remains today probably the best known method of application of this element for the treatment of human neoplasms. It usually takes the form of the introduction into the tissues, for a period of about a week, of metallic needles containing radium element or radium emanation, radon.

A lesser known form of interstitial implantation is the insertion of minute capillary tubes containing radon, called "seeds".

It was Duane, in the United States of America, who in 1916 first conceived the idea of seeds; and they were first used by Janeway[1] at the Memorial Hospital, New York. In those days, they were made of glass and so were unfiltered. Their use resulted therefore in an intense β ray effect in the surrounding tissues, leading in many cases to widespread sloughing. They have now been discarded in favour of filtered seeds.

Filtered radon seeds are of two types: (i) permanent implants, (ii) removable seeds. Removable seeds have threads attached, and in Australia are available made in gold with a screenage of 0·8 millimetre of platinum equivalent.

The purpose of the present paper is to draw attention to seeds of the first variety, which are left permanently in the tissues. This type does not require a thread, and for that reason can be made smaller in diameter than the removable seeds. Small diameter is an advantage in seeds which are to be left as foreign bodies in the tissues; but it is important not to diminish the diameter of the container below that which will effectively filter off the soft radiation given off, particularly the β rays.

For many years in Australia and elsewhere, gold seeds for permanent implantation have been made with a screenage of 0·3 millimetre. Abroad the tendency has been to increase this screenage to 0·5 millimetre, so that while the seeds are kept within reasonable size, the effects of soft radiation on the tissues adjacent to the seeds are avoided.

Within the last four years, following a request from one of us, the radon laboratory at the University of Sydney has made available for permanent implantation gold seeds with a screenage of 0·5 millimetre of platinum equivalent.

The exact technique of production of the seeds need not be elaborated in detail; but there are a few practical points of interest which do not arise in the making of the more commonly used radon needles. After purification, the radon is introduced into gold capillary tubing, and then this tubing is subdivided into seeds by the mere snipping off of the required lengths with a pair of blunt-edged pliers. This is sufficient to close the ends of the seeds, as pure gold welds under pressure. The γ ray activity of the seeds is then measured physically by means of an electroscope.

Paterson[2] states that from the point of view of local tissue tolerance, each gold seed in a permanent implant should contain not more than 1·3 millicuries. The most useful amount for most purposes will be found to be about 1·1 millicuries.

General Indications for the Use of the Method.

In general, it can be said that gold seed implantation should be employed in any inaccessible region where the use of larger and longer needles is difficult or impossible. Admittedly, in certain sites the question of choice between permanent implantation of seeds and the temporary insertion of removable platinum or gold needles may be a difficult one. The threads of removable needles may lead to the drainage of infection back into the tissues, and the discomfort caused by the presence of a number of threads when the lesion is in the mouth is a real entity.

With interstitial irradiation by means of radium needles it is necessary for the patient to be in hospital, both for nursing care, and also for constant supervision against loss of radium. With radon seeds, it is frequently possible to carry out the procedure under local anæsthesia in the out-patient department, or if not, to admit the patient to hospital for one night for short general anæsthesia. Moreover, one operation only is necessary—there is no removal, as with needles.

The advantages of gold seeds are therefore, firstly, that they are easier to apply than needles in sites where space is limited; secondly, that they are probably safer surgically; and thirdly, that the discomfort to the patient is less.

It may be considered inadvisable to leave foreign bodies indefinitely in the tissues; but in our experience so far we have seen no ill effects from the permanent implantation of these small seeds. On a few occasions after the malignant lesion has disappeared, seeds have been seen immediately subjacent to a mucosal or cutaneous surface; such seeds can easily be removed through minute incisions.

Radium therapy of late years has passed out of the empirical stage, and it is now possible physically to determine dosage in terms of the quantity of radiation delivered. Definite rules are now available for the distribution or arrangement of radium or radon containers in any particular treatment. A dosage system, which was introduced at the Manchester Radium Institute, has been described by Paterson and Parker.[3] This system, which enables doses in radium therapy to be expressed in "Röntgens", or *r* units of quantity of radiation, has now been taken up by many other centres.

In gold seed implantation, the distribution of the seeds should follow definite rules, and the dose should be accurately worked out. Haphazard implantation in the region of the growth can only lead to poor results and to discredit of the method. It is necessary first of all to determine the area to be irradiated, and in general a circular area will be chosen, as the distribution rules for homogeneous irradiation in this case are fairly simple. The seeds are implanted at a depth of 0·5 centimetre below the skin or mucosal surface, and the number of seeds and their total millicurie content can be arranged so as to produce a homogeneous dose of an appropriate number of *r* units over the area to be treated. As a general rule a dose of 6,000 to 6,500 *r* units is aimed at for malignant lesions. In accessible regions the usual needle implant or some other radiotherapeutic method, such as X-ray therapy, surface radium therapy or the radium bomb, will generally be chosen; but there are certain lesions and certain well-defined sites in which gold seed implantation has come to be regarded as of great value.

Some Special Indications for the Use of Radon Seeds.

Carcinoma of the Skin.

Surgical extirpation, either by excision or endothermy, of malignant skin tumours in certain situations must of necessity leave some degree of scarring or mutilation. Radiotherapy, on the other hand, provided due consideration is given to total dosage and dosage distribution, can produce permanent disappearance of such tumours with excellent cosmetic results. We have found the technique of permanent gold seed implantation especially valuable for lesions in the region of eye and nose—for example, basal-cell or squamous carcinomata involving the inner canthus of the eye, the eyelids or the naso-labial fold (Figure I). In such situations surface radium therapy or the implantation of long needles is difficult.

It is true that X-ray therapy, either by the contact low voltage method or at medium voltage, will cure many of these lesions with the minimum of disturbance to the patient. The value of X-ray therapy has been emphasized by Molesworth.[2] However, when there is deep infiltration or extension to the superior or inferior conjunctival fornices or to the orbital conjunctiva, gold seed implantation is probably preferable. Medium or low voltage X-ray therapy under these conditions becomes technically difficult of application and less likely to succeed.

Cavernous Angioma.

It is generally agreed that cavernous angiomata respond well to radiotherapy. We have found that in certain sites—for example, the tongue, the substance of the cheek or the palate—the most effective method is the implantation of gold radon seeds. The dose in these cases is kept uniformly lower than that used for malignant lesions, so that the subsequent reactionary symptoms are slight and the discomfort is minimal.

Carcinoma of the Mouth.

In epitheliomata of the hard palate either surface radium therapy by means of a specially constructed applicator or contact low voltage X-ray therapy will produce good results in many cases.

FIGURE I.
Gold radon seeds in rodent ulcers of the inner canthus and naso-labial fold.

In epitheliomata of the soft palate there are technical difficulties in the use of a radium applicator; in X-ray therapy by the contact method the accurate directing of the rays through the open mouth is not always easy. Moreover, if a large lesion was present several areas would have to be treated, and this would add further to the difficulties of accurate application of the radiation.

Epitheliomata of the palate have been successfully treated by implantation of gold seeds (Figure II). The method can be extended to lesions involving the anterior pillar of the fauces and the upper part of the tonsillar fossa, necessitating the insertion of some seeds into the tongue and cheek, so as to be well wide of the lesion.

A fairly common lesion in this situation is a carcinoma involving the upper pole of the tonsil spreading to the anterior pillar of the fauces, down to the base of the tongue, and not infrequently medially to the palate.

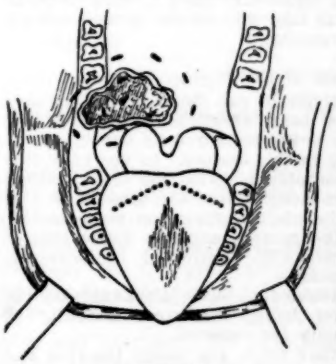

FIGURE II.
Gold radon seed implantation in carcinoma of the soft palate.

When the tongue involvement is extensive or deeply infiltrating, a needle implantation may be preferable to gold seeds; but certain cases are often best dealt with by a combination of an implantation of two planes of needles (in the tongue and cheek respectively) with gold seeds in the palate.

In carcinomata of the tongue the usual form of radium treatment is implantation of needles. Gold seed implantation, however, has a definite place in the treatment of lesions, especially those on the dorsal and lateral aspects, and in the case of old people, when the less interference there is, the better. In the latter case, the application of seeds is preferable because there is only one slight operation, with no uncomfortable needles or threads and little risk of post-operative complications.

Souttar[6] uses gold seeds for lesions on the base of the tongue; his technique is to insert the introducer from the neck below the jaw. We prefer the intraoral approach.

Martin and Sharp[8] state that they "believe the gold seed to be the most efficient and practical form for interstitial irradiation in intraoral cancer".

Carcinoma of the Pharynx.

The first choice in the treatment of most carcinomata of any part of the pharynx is external radiotherapy, either by deep X-ray therapy or by the radium bomb. The results from this type of treatment have greatly improved in recent years, and will probably continue to do so with greater appreciation of the importance of adequate tumour dosage, and of the exact directing of radiation beams. Nevertheless a place will be found for local radium treatment in certain cases, in which either partial or practically no response to intensive external irradiation takes place. In the oral pharynx and hypopharynx, with growths reasonably accessible through the mouth and of reasonably small size, gold seed implantation is practicable. Martin[9] has recently drawn attention to the value of this method. We have had successful results in this type of case.

Carcinoma of the Larynx.

There is no doubt that irradiation holds a very important place in the treatment of laryngeal cancer. Coutard[11] has shown indisputably the value of deep X-ray therapy given in adequate dose and according to certain well-defined principles. The value of radium therapy is perhaps less widely known.

Of local radium therapy, the method of Harmer, who dealt with carcinomata of the true vocal cord by window resection of the thyreoid cartilage and insertion of radium needles, is perhaps the best known.

Douglas Quick[10] in an important paper has pointed out the great value of radon seeds in laryngeal cancer. He implants them after exposure by thyreotomy or laryngofissure. It is interesting to note his statement that he is "convinced that today our foremost aid (in laryngeal cancer) is roentgen irradiation applied after the basic principles of Coutard". He is of the opinion that "the present status of radiation therapy renders total laryngectomy obsolete"; and again: "the early cancer is as favourable for irradiation as for surgical extirpation. The ultimate result is better. The real problem is the more advanced case in which surgery never has been interested".

His methods are therefore to employ deep X-ray therapy as a first choice; in the event of failure or incomplete resolution, then he uses conservative surgery, generally thyreotomy, associated with gold radon seed implantation. He gives details of many successful cases to support these opinions. It would appear that this method is well worthy of adequate trial in Australia.

Carcinoma of the Bladder.

Evidence of the sensitivity of carcinoma of the urinary bladder to radium has been given by many writers. Nevertheless, irradiation is not employed by any means as commonly as it might be in this disease. In our view this may well be due to dissatisfaction with the older method of inserting long radium needles into the bladder and to non-acquaintance with the use of gold radon seeds in this connexion. Moreover, the modern accurate estimation of radium dosage has practically eliminated radionecrosis with its disastrous sequelæ.

Radium needles undoubtedly have disadvantages in bladder work, the chief being the great difficulty of insertion, and the necessity for removal.

Radon seeds, as in other sites, are easily inserted and no second operation for removal is necessary (Figure III). Suprapubic cystotomy is first performed and the growth is exposed clearly. Any protuberant tumour may be removed by endothermy; seeds are then implanted over an area which extends well wide of the base of the tumour (Figure III). We have carried out this method in association with urological colleagues in many cases during the last three or four years, and many of the results have been most impressive.

Hutchinson[9] has written an informative article on this subject; he quotes the results of treatment of nine patients, all of whom had fairly large growths, the smallest being four by three centimetres in size. In spite of this, three patients were alive and well over two and under three years after treatment.

The insertion of gold seeds through the operating cystoscope is not recommended, because of the impossibility of ensuring an accurate and even distribution of the seeds.

Carcinoma of the Rectum.

Souttar[6] has employed gold radon seeds in carcinoma of the lower part of the rectum, implanting them in columns in the perirectal tissue.

Binkley[10] has published results of radiation therapy in primary operable rectal cancer. His radiotherapeutic technique consisted of external irradiation in the form of either the radium bomb or deep X rays, followed by radium therapy, either gold seed implantation or a rectal radium applicator. He generally implants the seeds in small lesions in the lower part of the rectum through the proctoscope. His results have been most encouraging.

FIGURE III.
Gold radon seeds in carcinoma of the urinary bladder.

Malignant Tumours in Other Sites.

Radon seed implantation has produced a few successes in the treatment of malignant tumours in other sites.[12,13] That the results have not been uniformly satisfactory is probably largely due to the fact that adequate dosage distribution throughout the tumour volume has not been achieved, either because the importance of this was not realized, or because it was technically difficult of attainment.

In such conditions as bronchogenic carcinoma, carcinoma of the œsophagus and stomach and cerebral tumours, we believe adequate trial of this technique in selected cases is warranted.

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The Medical Journal of Australia

SATURDAY, NOVEMBER 29, 1941.

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THE CONCEPT OF THE SPECIFIC IN MEDICINE.

THERE is in human nature a love of the clear-cut and precise, and with this there will be found a preference for those doctrines which possess a rigid simplicity. Quite apart from considerations of theological unorthodoxy, the acceptance of the Copernican system was hampered by the postulated threefold motion of the earth whereas formerly the earth had no movement at all, and the intelligent man in the street did not worry how many epicycles were imposed upon the distant planets, with which he was not directly concerned. In the history of medicine the concept of the specific has played a not inconsiderable role, for no matter how often it has passed into eclipse or semi-eclipse, it has always emerged with undiminished or indeed augmented lustre.[1] Opinion, both lay and professional, has swung with major fluctuations between two extremes, which might be designated the catholic and the specific, and often after a long interval of time a position is reached not very different from what had been earlier attained. For example, when Virchow in the middle of the nineteenth century declared that diseases were normal vital processes whose manifestations were due to uncommon circumstances and departing from states of health only in quantitative degrees, he was really enunciating the medical philosophy of Hippocrates. Medicine reached one extreme of the specific under Sydenham, who separated and classified diseases as individual entities in much the same manner as Linnaeus separated and classified the world's plants. The nineteenth century was witnessing a mild reaction against this fixity of specifism when, like a bolt from the blue, came the discovery of bacteria and the vogue of the specific had its greatest triumph. A few wise physicians, like Osler, ventured to suggest that the soil was as important as the seed, and others refused to admit the universality of bacterial causation; but these protesting voices were inaudible in the loud acclaim which greeted the parasitic theory of disease. To this day bacteriology dominates pathology and, as might be expected, this has given rise to the quest for the specific therapeutic agent. Strongly established as the bacteriological concept may appear in modern medical thought, it has not escaped some shrewd and disconcerting blows. The rise of endocrinology was one of these, and though brave attempts are constantly being made to find for supernormal, subnormal or chemically aberrant activity of each gland a cause in some septic focus, the great bulk of endocrinological experiment and opinion is detached from the theory of invading parasites. Then unexpectedly there burst upon the medical world the discovery of avitaminosis, which is purely nutritional and which could still occur in an aseptic universe. The idea that a definite disease like beri-beri could be due to the absence of an accessory factor in diet was greeted with Homeric laughter by the giants of tropical medicine, who sought the explanation of every tropical illness in a parasite carried by an insect vector. Modern investigation is very busy with those substances, inorganic and organic, whose presence even in minute amounts is necessary for health, and here once more a dissociation from bacteriology has existed from the first. In our own particular time the critical advance against the sovereignty of the concept of bacterial invasion is taking place from two directions; on the one aspect we have modern psychology, with its complex apparatus of repressions and perverted stimulations, conscious and subconscious, which do not necessarily postulate a toxic material agent from without. On the other side we have the modern science of heredity, where the conception of gene linkages has illuminated strange byways of both mind and body. These many and growing abridgements and qualifications of the parasitic theory are leading us once more to a broad catholic outlook, which should surely be the attitude of medicine today. That the good doctor is also a philosopher was declared by Galen in the age of Marcus Aurelius, and this aphorism we can accept so long as we do not limit philosophy to the metaphysical.

[1] A thoughtful address on the concept of the specific in medicine was given on March 10 of this year to the College of Physicians in Philadelphia by Dr. Iago Galdston and is published in the *Transactions and Studies* of this body in April, Volume IX, page 25.

BIOLOGICAL CHEMISTRY AND THE SURGEON.

IT is interesting to note how surgery during the enlargement of its scope and efficiency has entered the domain of one science after another and acquired strength by the invasion. Not so very long ago the one scientific study necessary for the good surgeon was anatomy, and an intimate acquaintance with the architecture of the human body still remains an essential prerequisite for surgical study and practice. The physiology required was to all intents and purposes that given to the world by William Harvey. Then with one stroke Lister added bacteriology to the surgeon's store of working knowledge, and bacteriological principles and possibilities are today ever present in the surgeon's mind as he operates. The discovery of X rays hardly added to the repertoire of technical knowledge, for the proper use of this physical agent needed a specialist, and the surgeon was interested only

in the interpretation of the result, just as an histologist has only a bowing acquaintance with the optical theory of his microscope.

Today more and more is the surgeon thinking of function, and his thoughts move constantly in that wide condominium where physiology overlaps pathology, discussed in these pages in the issue of March 2, 1940. Not only has he to consider the specific activity, if indeed there is such a thing, of the organ or tissue which is the object of his operative procedures, but the remoter perturbations and imbalances which may supervene as the result of his interference. Nowhere is this more manifest than in the alimentary canal, where a departure from normal in one level affects all other levels, above and below, and where too much attention to one detail of activity in one region may recommend an operation which occasions unexpected sequelæ elsewhere. Readers of Sir Hugh Devine's recently published work on abdominal surgery will observe with pleasure that the author never loses grasp of the importance of function in his detailed handling of diagnosis and treatment; his aim is not merely to remove a danger, but to improve disabled function and so to aid Nature in the true Hippocratic tradition.

What should be the attitude of the surgeon towards biological chemistry? There are two alternatives. One is to accept without criticism the findings of the biochemical specialist and to add these to the diagnostic data already assembled. There is, however, a danger in this course of action, for a new biochemical technique may be presented with exaggerated claims for accuracy, and the evidence evaluated, however near to correctness, may be given a wholly undeserved significance. When Professor Benedict invented a beautifully simple instrument for estimating basal metabolism, he hardly expected that some surgeons would embark on thyreoidectomy as a result of data obtained by girls of fifteen entrusted with the working of the apparatus. His warning to the profession was timely and salutary. The other alternative, and surely the more admirable, is that the surgeon, during the discipline of his medical studies, should undergo a course of training in clinical biological chemistry, which though insufficient for immediate specialist application, would nevertheless give him a good idea of the scope and limitations of the methods and the possibilities of error and allow him to discuss the findings intelligently with the biological chemist, who would be only too pleased to learn that his science was appreciated. Indeed one may affirm that there is no recognized component of the medical curriculum, clinical or pre-clinical, which may not be called upon for assistance in the selection of operative methods. The popular idea of the good surgeon is a man possessing exceptional manipulative skill; it is rarely realized by the layman that the really outstanding characteristic of the good surgeon is exceptional knowledge and judgement.

Current Comment.

SHOCK.

ALTHOUGH shock is a condition only too well known in its clinical manifestation to physicians and surgeons, its mechanism is yet but incompletely understood. Intensive research work has not yet yielded quite satisfactory results because it has been hindered by a number of difficulties, one of them being that very little investigation can be carried out on man because a patient in shock is in a state which does not allow the performance of numerous or difficult tests. Most of the work has therefore to be done on animals, and here more than on other occasions the question arises as to what extent and with what accuracy results obtained with animals can be applied to human conditions. Confusion has further arisen on account of our incomplete knowledge of the function and reactions of the capillaries which, it is certain, are the centre of the pathological syndrome. Another cause of confusion has been the failure to distinguish between shock and the effects of hæmorrhage. Other factors which have hindered the clarification of the problem, are errors inherent in experimental methods and differences of opinion about the significance of morphological changes in the body tissues. Very many papers dealing with shock, too numerous to be reviewed, are being published in the medical journals; but a discussion of this subject which has taken place at the last annual meeting of the American Association of Pathologists and Bacteriologists in April, 1941, seems worthy of discussion.

At this meeting a number of authors presented the results of their experimental work aiming to shed light on one side or the other of the problem.

T. J. Curphey and E. Ponder[1] showed that shock in rabbits and guinea-pigs produced a leucocytic response in the form of an increase of the polymorphonuclear cells and a "shift to the left". Attempts have been made to assay this effect against that of a standard bone marrow stimulant, and this has been more successful in guinea-pigs than in rabbits.

B. Rose and J. S. L. Browne[1] dealt with the role histamine plays in shock. They found that in shock, whether induced by trauma or by subcutaneous injection of histamine, and during hæmorrhage, the histamine content of the whole blood is decreased and that of the plasma increased. As yet they are unable to decide whether the increase in the histamine content in the plasma or the decrease in that of the whole blood is the more significant. The application of such findings is especially difficult because this feature as seen in the rabbit is opposite to that in the dog.

D. R. Morgan, M. M. Lieber and R. McGrew[1] drew attention to one of the aspects mentioned above, the differences between shock and the effects of hæmorrhage. In shock there develops a hæmo-concentration of about 40%, with an increase in the hæmoglobin values, specific gravity, red blood cell count and white blood cell count, prolongation in the coagulation time and a marked fall in the sedimentation rate. There is a decrease in plasma volume, in plasma protein and in carbon dioxide content and an increase in the blood non-protein nitrogen content and an inconstant rise in the level of the blood sugar. Conversely the blood of dogs after hæmorrhage shows a distinct and immediate hæmo-dilution with a decrease in the red blood cell count, hæmoglobin and specific gravity, a slowing of the coagulation time and an increase in the sedimentation rate. There is an increase in the plasma volume, the plasma protein, the plasma carbon dioxide and blood non-protein nitrogen content. The blood sugar level shows an agonal rise. The lymph flow is increased in shock and decreased after hæmorrhage. The parenchymatous tissues have a greater water content in shock than after hæmorrhage. The urine in shock contains albumin, red blood cells, casts, bile salt and pigments and occasionally urinobilinogen. The urinary findings after hæmorrhage are normal. There is a marked difference in the response to hæmorrhage at the critical blood pressure level of 80 millimetres of mercury. Dogs with shock could be brought to the point of death with a single small hæmorrhage, whereas dogs subjected to hæmorrhage withstood subsequent bleeding.

[1] *The American Journal of Pathology*, July, 1941.

M. M. Lieber and D. R. Morgan[1] described the morphological changes which they observed in experimental shock. They found generalized capillo-venous congestion most prominent in the liver, kidneys, gastro-intestinal mucosa, lungs and serosæ. Frequent petechial hæmorrhages were noted in these tissues and also in the epicardium, meninges and brain. When death was delayed the soft tissues were œdematous and there were effusions in the serous cavities. Parenchymatous degeneration of the viscera was the rule. Focal necroses were noted in liver, spleen, lymph nodes and adrenal glands in a number of animals. These morphological features are, in the opinion of Lieber and Morgan, directly related to capillary injury with increased permeability resulting in circulatory deficiency and anoxia of the tissues. They emphasize that the various tissues present a variety of changes which are dependent on several factors, including the nature of the shock-producing agent, the intensity or quantity of that agent and the period of time over which it acts before death is produced. The severity of the pathological changes does not always parallel the degree of shock produced. Under identical conditions of experimentation the degree of distribution and the changes may vary in different animals of the same species. When asked in the discussion on their paper whether similar changes have been found in patients who died as a result of shock, Lieber and Morgan were very hesitant to state an opinion since post-mortem changes occur in shock so rapidly that material not obtained within two hours after death cannot be used for interpretation.

It is interesting to compare their conclusions with those of a paper by Harry A. Davis,[1] which was not read at this meeting. Davis found practically the same changes in the tissues, but in his opinion they should not be considered as pathological. They should, according to him, be taken as an anatomical expression of the physiological changes which the body must make to minimize the effect of oxygen deprivation. This example will suffice to show how far we still are from an agreement about the interpretation even of well-established facts. Nevertheless, a paper read by Virgil H. Moon[1] at the same congress gives a good summary of our present state of knowledge. Endothelium is, according to him, highly susceptible to the effects of various agents and conditions. These include bacterial substances, foreign proteins, and split-products, extracts of normal tissues, histamine, bile, venoms, chemicals, poisons, metabolic products and even moderate lack of oxygen. Any type of injury to endothelium increases its permeability to plasma colloids. Leakage (through the intercellular spaces) of plasma from the blood produces hæmoconcentration, lowers the total blood volume and leads to a disparity between it and the volume capacity of the vascular bed. This disparity, if uncompensated, manifests itself in the characteristic signs of shock. The syndrome is accompanied by distinctive physiological disturbances and pathological features which are related directly to endothelial damage. Abnormal permeability of endothelium disturbs seriously the mechanism of water balance. Normal movement of fluid between the blood and the tissues depends upon several factors, including capillary blood pressure, osmotic pressure, concentration of electrolytes and others. But the action of these forces, in maintaining physiological relations between intravascular and extravascular fluids, is absolutely conditioned upon the presence between them of a normal semi-permeable membrane—the endothelium. Circulatory deficiency of this type is accompanied by vomiting, diarrhœa, œdema, hæmoconcentration and inability to absorb fluid from the tissues. These features indicate disturbances of fluid balance. Abnormal cellular permeability also is an important factor. The outer surface of each living animal cell functions like a semi-permeable membrane. Hence each cell behaves as an osmotic unit. Living protoplasm maintains chemical concentrations differing markedly from those of the external fluids; but this property is reduced by any kind of cellular injury and is lost entirely as the cell dies. This allows the differences in concentration to be equalized and accounts for a number of chemical alterations of the blood during shock. This type of circulatory failure may develop after extensive traumatic injury, surgical procedures and burns. It occurs also as a complication of abdominal emergencies, intoxications, infections of unusual severity, serum disease and in acute poisoning of various kinds. When it follows trauma or surgical procedures, it is usually complicated by hæmorrhage and by other factors; but it can be produced in uncomplicated form by various agents which injure endothelium.

Moon also stresses the importance of distinguishing between shock and the effects of hæmorrhage, mainly along the lines of the paper by Morgan, Lieber and McGrew referred to above. Several of the clinical signs are identical, but other features are opposite in character, and it is especially significant that none of the morphological changes found in shock result from the effects of hæmorrhage. Moon criticizes methods commonly used to produce experimental shock. If one narcotizes an animal deeply then produces extensive trauma to the tissues and uses a decline in blood pressure as the indicator of shock, one cannot obtain conclusive results as such a combination of indeterminate factors leads only to confusion. One of the most important results of animal experiments, however, is that they confirm the interpretation that the absorption of products from damaged tissue is one of the major factors in producing shock. Moon is convinced that the morphological changes found in the viscera are pathological and not just the anatomical expression of physiological changes, as Davis suggests. They are indicative of endothelial damage and support the interpretation that various agents, including products absorbed from damaged tissues, exert deleterious effects upon capillary walls and thereby initiate a group of physiological disorders leading to circulatory deficiency and to lack of oxygen in the tissues. This factor of itself causes endothelial permeability and thereby introduces a self-perpetuating feature. Thus a vicious circle is formed in the following manner. Direct injury or the action of a number of various agents or conditions causes damage of the capillary endothelium. The most important of the resulting effects is the reduction of the blood volume which might be further aggravated by hæmorrhage. This will lead to a reduced flow of blood. Cardiac inefficiency, circulatory obstruction or hyperactivity of the sympatho-adrenal system, when present, will further enhance this condition. The oxygen supply to the tissues will therefore become diminished and the result will be tissue anoxia. Such tissue anoxia will either directly or by way of products of deficient oxidation aggravate capillary atony and damage and thus close the vicious circle.

The discussion at this American meeting did not terminate before two papers dealing with therapeutic aspects of shock were read. W. C. Hueper, G. J. Martin and M. R. Thompson[1] suggested the intravenous administration of macro-molecular substances to counteract the excessive capillary permeability. They injected colloidal solutions of methyl cellulose fortified by the addition of natural detoxicants with good results in laboratory animals. G. H. Whipple[1] found that an enzymatic digest of commercial casein given parenterally is as effective in plasma protein production as whole liver by mouth. This digest provides material needed to correct the hypoproteinæmia as well as nitrogen for other body protein requirements. It seems possible that it might replace to a certain extent plasma transfusions given in shock.

Although it can thus be seen that many questions of the problem "shock" are still unsolved, it is certain that a solid foundation has now been laid upon which a better understanding of the mechanics and dynamics of shock can be built. Only such an understanding will pave the path for a reasonable treatment of a condition which as yet too often defies all our efforts.

[1] *Archives of Surgery*, May, 1941.

[1] *The American Journal of Pathology*, July, 1941.

Abstracts from Medical Literature.

OPHTHALMOLOGY.

Eye Lesions following Infection of the Sphenoidal Sinuses.

E. W. ARNDT (*The British Journal of Ophthalmology*, July, 1941) reports two cases in which the eyes became affected after infection of the sphenoidal sinuses. The first was that of a woman, thirty-two years of age, who suffered from an influenzal cold and a week later complained of severe pain behind the right eye and across the forehead, and of diffuse redness and swelling of the face. She was given salicylate of soda and fomentations were applied. Vision in each eye began to fail and was reduced to 3/60. A diagnosis of retrobulbar neuritis was made and the patient was admitted to hospital. Gradual improvement occurred, but after a few days a relapse took place and vision, which had improved to 6/18 in both eyes now deteriorated to 2/60. The sphenoidal sinuses were reported to be infected. Operation was performed; the mucous membrane of the sinus was found to be very congested and a bead of pus was seen. The day after operation one short-wave diathermy treatment was given, and two days later extensive retinal detachments were seen in the lower halves of both eyes. The patient was given atropine and fomentations to the eyes and was ordered a mixture containing iodide of soda. Absolute rest in the semi-recumbent position was ordered. A further operation was performed, when the right sphenoidal sinus was well opened and good drainage was established. After one month diathermy was added to the treatment and intramuscular injections of calcium were ordered. The patient made an uneventful recovery and both detachments were completely reposed. In the second case the patient, a woman of twenty-eight years of age, also had an influenzal cold. Optic neuritis occurred in one eye and recovery was complete after operation on the sphenoidal sinuses. The author draws attention to the extent to which the optic nerves can be damaged without the presence of frank suppuration. He believes that complete rest in the semi-recumbent position should be given a thorough trial in detachment of the retina when no tear can be seen. He also states that when the cause of inflammation of the optic nerve cannot be definitely traced and the condition does not respond to treatment, sufficient "bloodletting" from a high operation in the nose often tends to bring about favourable results.

The Intraocular Pressure.

THOMSON HENDERSON (*The British Journal of Ophthalmology*, August, 1941) writes on the mechanism of the intraocular pressure in mammalia. He points out that if, as is alleged, the intraocular pressure is two and a half times greater than intracranial pressure, many clinical and physiological problems are insoluble, but that they cease to exist with the realization that the same mechanism and the same level of pressure, about 10 millimetres of mercury, obtain in the eye as well as in the brain. As an example of such a problem he asks why the eye should require such a high level of pressure. It is held that a high pressure is necessary to keep the eyeball distended and to maintain its form as an optical instrument. The author shows that the maintenance of the form of the mammalian eye depends not on the pressure exerted from within, but upon the rigidity of its covering. The key to the understanding of the mechanism of the intraocular pressure is seen in the reaction of the central retinal vein at the optic disk to the slightest touch on the lid. This supplies clinical proof of the equilibrium between the intraocular pressure and the venous exit pressure. The intraocular pressure is not dependent on volume, but is maintained by and varies with the venous exit pressure because this is the lowest circulatory pressure in the closed sphere of the eye. It is the general circulatory pressure on the venous side which governs the physiological level of the intracranial and intraocular pressures and maintains them at 10 millimetres of mercury. Every variation in *vena cava* pressure is reflected backward millimetre for millimetre in both brain and eye. Variations in arterial pressure produce only a proportional change, as between the aorta and the venous exits in brain and eye the unknown and varying resistance of the arterioles has to be overcome.

The Care of Children's Eyes in the Public Schools.

RODMAN IRVINE *et alii* (*American Journal of Ophthalmology*, July, 1941) present a report on the policy to be pursued in the examination of the eyes of children in public schools. They divide the problem into four headings: (i) methods of examination sensitive enough to detect eye conditions that handicap the child in school work, yet easily and accurately carried out under conditions of mass testing; (ii) preventive or "sight conservation" measures; (iii) reading problems; (iv) care of patients unable to pay a private physician. Abnormalities that do not actually interfere with the child's learning processes may in most instances be disregarded. Visual acuity of less than 20/20 in children aged over ten years and of less than 20/30 in younger children, and amplitude of accommodation of less than five diopters in the older group, should cause the child to be referred for ocular examination. More than average difficulty in reading indicates the need for ocular examination regardless of the distance vision. Muscle imbalance is not such a handicap as diminished visual acuity; but examination for the condition, which is easily discernible, should be included in the school routine tests. No expensive and complicated pieces of commercial apparatus are necessary in school examinations; they may do more harm than good by giving a false sense of accuracy and completeness, and by causing the eyes to be observed under abnormal conditions of use. Sometime early in the school career tests for colour vision should be made. Ordinary conditions of use do not damage the eyes. Sound evidence is lacking that poor lighting conditions, concentrated close work, failure to wear glasses, and even the wearing of wrong glasses, produce refractive errors, injure the focusing apparatus or damage the retina or optic nerve; but bad conditions are nevertheless to be eliminated, since proper conditions for seeing facilitate performance. Commercial equipment claiming to be for "conservation of sight" should instead be designated "conveniences for seeing". If the eyes have average vision, reading difficulty should be considered a problem for the educational psychologist rather than an eye problem. Ocular difficulties responsible for poor reading are easily recognized. There is no reason why the eye should not learn to recognize symbols as early as the ear learns to recognize sounds. The "flash" method of teaching to read is suitable only for children primarily of the visual type. Money spent on expensive pieces of apparatus for teaching children to read by this method would be better spent in salaries, to decrease the number of pupils per teacher. There is no evidence that the recording of eye movements can be an aid in the diagnosis of reading difficulty. Methods of running school clinics for children with defective eyes who are unable to pay for medical care should be simplified, and use should be made of existing facilities in the community. Orthoptic training for correction of cross-eyes and muscle imbalances is not advisable or practical in school clinics. Such training is more complicated than is generally recognized, and much time is required to obtain results, which are often transient.

Wernicke's Syndrome Complicating Pregnancy and Associated with Ocular Complication.

GEORGE BLACK (*The British Journal of Ophthalmology*, September, 1941) writes that Wernicke in 1881 described the syndrome that bears his name as an acute superior hæmorrhagic polioencephalitis. In his three cases there were minute hæmorrhagic foci in the walls of the third ventricle, in the grey matter around the aqueduct and in the floor of the fourth ventricle. In recent years views in regard to the ætiology and pathology of the condition have changed. According to modern authors the condition is either due to an endogenous toxin or it is the result of a vitamin deficiency. The author refers to experimental work by Alexander on pigeons, in which he produced the condition with regularity in the presence of the deficiency of vitamin *B* as a complication of beri-beri after large supplies of other vitamins had been given. The author's patient recovered and the diagnosis is therefore unconfirmed. When she was three months pregnant she had severe headaches and sickness. Vision began to fail and retinal hæmorrhages appeared. There were no exudates and the appearances were unlike those of albuminuric retinitis. The vision of each eye was reduced to the perception of hand movements. No ocular paralysis was present, but the patient was very drowsy. The blood pressure was normal and the urine was clear. Recovery was dramatic and rapid after intensive treatment with vitamin *B*.

OTO-RHINO-LARYNGOLOGY.

Closure of Operative Fenestræ in the Labyrinth.

E. P. FOWLER (*Archives of Otolaryngology*, August, 1941) reviews the work of American and European operators on the closure of operative

fenestræ in the labyrinth. He confirms the fact that in approximately two out of three cases the artificial fistula tends to close within two or three months of operation, so that the improvement of hearing tends soon to be lost again. As a result of anatomical study, in which careful measurements were made, it is claimed that Lempert's contention is impossible, that in his operation he covers the fistula with Shrapnell's membrane. It is also pointed out that Kopetsky reported a case in which an open fenestra was obtained after an operation in which no skin flap at all was placed over the operative fistula. It is thus implied that it cannot be on account of the use of Shrapnell's membrane that Lempert has appeared to secure somewhat better results than others. In order to determine what takes place after a fistula is made and after the use of a variety of instruments, including chisels and various grades of burrs, operations were performed on both sides in seven large monkeys, and sections were made of the area containing the fistula from three days up to eighty-five days after operation. Study of these cases revealed that in monkeys a closure of the fistula was always the rule, whatever instruments and methods were used. Although the most profuse growth of bone appeared to be from the periosteal capsule, definite growth occurred also from the endostium and from the endochondral layer. Grafts, which were placed over the fistula at operation, comprised flaps from the external auditory meatus turned back after the methods of Lempert and Sourdille, and conjunctival grafts. In most instances the major part of the epithelium was absorbed. There was also noticed the formation of pockets and epithelial cysts, some of which appeared likely to develop cholesteatoma. The author offers no fresh suggestions which might render the operation more uniformly successful in the human being, but suggests that further animal experimentation should be carried out.

Treatment of Septic Thrombophlebitis of the Cavernous Sinus.

L. A. SCHALL (*The Journal of the American Medical Association*, August 23, 1941) reports three cases of septic thrombophlebitis of the cavernous sinus in which all three patients recovered. The writer has followed the diagnostic criteria set down by Eagleton in arriving at the conclusion that the cavernous sinus was thrombosed. Thus orbital œdema, blood stream infection, involvement of adjacent nerves and some metastatic foci were present. Recovery is attributed to the use of heparin together with sulphathiazole. Heparin is administered intravenously by a constant saline solution drip. One thousand units are added to each 100 cubic centimetres of saline solution. The solution is permitted to run in at such a rate that the clotting time of the patient's blood is maintained at about ninety minutes. From analysis of the author's case reports it is seen that the administration was carried out over a period of about ten to eighteen days. The initial daily dose is recorded in one case report as 20,000 units. In another 580,000 units were spread over eighteen days, and in the third case 225,000 units were administered in sixteen days. Sulphathiazole was given in doses sufficient to maintain a blood level of 5·0 milligrammes per 100 cubic centimetres, and continued for a long period after the administration of heparin was discontinued. The author suggests that the importance of heparin as an adjunct in treatment was demonstrated in one of the cases especially, in which the cavernous involvement developed while the patient was under treatment with chemo-therapeutic agents for a nasal furunculosis.

Analgesics in Otology.

JUAN MONTERO (*Revista Médica Latino-Americana*, February, 1941) condemns the use of drops in painful conditions of the ear. When oil is the vehicle, maceration of the epithelium of the auditory canal with predisposition to eczema, pyodermatitis, otomycosis *et cetera*, results from oxidation of the oil. Carbolized glycerine has no place in modern otology. Its disadvantages are: (i) the strength is seldom standardized; (ii) its caustic and dehydrating action may lead to burning or gangrene; (iii) women and children may be especially sensitive to it; (iv) it may have a toxic action on patients suffering from diabetes, anæmia and leprosy. In non-perforating acute *otitis media* the use of carbolized glycerin may mask important signs of the course of the disease; the hearing may be permanently damaged. In such cases the correct treatment is early paracentesis. Carbolized glycerin has no place in the treatment of the pain of chronic suppurative *otitis media*; the cause of the pain — impaired drainage of the middle ear—must be treated.

Acute Laryngotracheobronchitis.

H. B. ORTON *et alii* (*Archives of Otolaryngology*, June, 1941) present an analysis of 68 cases of acute laryngotracheobronchitis with autopsy reports on eight. The majority of the patients were aged under three years; 47 recovered and 17 died. The ætiological agent remains obscure. Swab cultures revealed a predominance of streptococci, while staphylococci and pneumococci were frequently also obtained. The low blood count observed in some cases is suggested as supporting evidence of a possible part played by a filtrable virus. Gross pathological changes were observed in the epiglottis, larynx, subglottic area and trachea. The true vocal cords may show comparatively little reaction, but the subglottic area and trachea are intensely inflamed, and gangrenous pseudo-membranes may be seen on these parts. Thick, tenacious, mucous plugs also add to the obstructive changes. In the lungs, as well as the tracheal changes, bronchopneumonia and areas of atelectasis and emphysema are found. The disease commences with an infection of the upper respiratory tract. Soon illness becomes acute and is accompanied by high fever, rapid pulse, severe respiratory distress and an appearance suggesting toxæmia. Hoarseness appears early, and there is a croupy cough due to subglottic œdema. Later dyspnœa, retraction and pallor follow, but not often cyanosis. Dyspnœa and retraction soon become more pronounced and death occurs by slow suffocation. Diphtheria is the principal mistake in diagnosis, while less serious forms of acute laryngeal catarrh may cause confusion in the early stages. Cultures of material from the larynx should be made without delay, and when doubt arises direct laryngoscopic and bronchoscopic examination should follow. Two lines in treatment are emphasized. To relieve dyspnœa, intubation may be performed in an emergency, but tracheotomy must follow as soon as possible. The second essential is an atmosphere supersaturated with moisture and a room temperature of about 70° F. An apparatus which will humidify and warm the whole room is regarded as superior to a tent. Constant close watching of the patient is essential. The airway must be kept clean with mucus solvents, such as saline or sodium bicarbonate solution, and with a suction apparatus to remove secretions. Repeated bronchoscopic treatment may be necessary for more effective aspiration. Iodides may help as expectorants, but opiates and belladonna are strongly condemned. Sulphonamides are thought to have helped, but are not a specific for the disease. The warm saturated atmosphere and early tracheotomy with adequate after-care are considered the two essentials in treatment.

Chemotherapy.

E. E. OSGOOD (*Archives of Otolaryngology*, June, 1941) quotes extensive references to earlier publications by himself and others dealing with human marrow culture, and reports the result of observations by this method to determine the effectiveness of concentration of chemotherapeutic agents against bacteria, and the tolerance to them of blood-forming tissue cells. The importance of early bacteria tests to determine which organism is active is stressed. The author concludes that the agent of choice against the majority of infections is sulphathiazole, and that against the most severe staphylococcal or *Streptococcus viridans* infections the drug of choice is neoarsphenamine, either alone or in combination with sulphathiazole. The need for maintaining a high blood concentration of the drugs employed is emphasized. Sulphathiazole should be kept at a level of 5·0 to 8·0 milligrammes, and sometimes 10·0 milligrammes, per 100 cubic centimetres. When neoarsphenamine is employed, a blood level of 100 to 130 microgrammes of arsenic per 100 cubic centimetres should be aimed at. This can be maintained with a unit dose of 0·8 milligramme of the drug per pound of body weight, given every four hours for four doses on the first day, and every eight hours for three doses on each subsequent day, the treatment continuing for ten days. If the temperature is then normal, rest periods of three to six days with a three-day course of therapy are advised thereafter for up to sixty days.

Naso-Pharyngeal Fibroma.

T. E. HUGHES (*Archives of Otolaryngology*, July, 1941), in reporting a case of naso-pharyngeal fibroma, reviews the literature dealing with this condition. There has been considerable controversy as to the exact site of origin. The majority of authors, however, agree that it is from the periosteum of the basi-sphenoid and occipital bone that growth commences. Although the author did not use it in his own cases, but preferred to drag the tumour from its attachment with a heavy wire snare, it is pointed out that radium therapy seems to be the method of choice according to the majority of recent writers and that this method has proved superior to any other form of surgical treatment.

British Medical Association News.

SCIENTIFIC.

A MEETING of the Queensland Branch of the British Medical Association was held on August 1, 1941, at the Brisbane Hospital, Brisbane. The meeting took the form of a series of clinical demonstrations by members of the medical staff.

Chronic Osteomyelitis of the Temporal Bone.

DR. HERBERT EARNSHAW showed a male patient suffering from chronic osteomyelitis of the left temporal bone secondary to superficial gangrene of the skin, for which he had been admitted to hospital in December, 1940. Chronic otorrhœa had been present for some time previously, and left facial paralysis had occurred while he was in hospital. A radical mastoidectomy was performed on February 13, 1941, and the cellular part of the mastoid process, the bony meatus, the *tegmen antri* and the *tegmen tympani* were found fragmented and lying in pus. The diseased bone was removed and the middle ear and facial ridge were treated as in the radical operation. A meatal flap was not cut, however, and the edges of the post-aural incision were packed wide open. Free drainage of pus occurred for some time from the meatus and also from the post-aural incision. The swelling in front of the external meatus, which was a pre-operative symptom, persisted, and an X-ray film, taken at this time revealed osteomyelitis of this region. The patient was at this time in the observation ward, and good X-ray pictures were difficult to obtain, as the result of his lack of cooperation. On August 1, 1941, the patient's general condition was good, the post-aural area was fairly clean, and an area of dead bone could be seen in the meatal part of the temporal bone. Paralysis of the seventh nerve was present and the external auditory meatus was stenosed.

Corneal Graft from the Cadaver.

DR. W. L. GIBSON discussed corneal graft from the cadaver. He said that ten years earlier he had shown at a clinical meeting a patient suffering from detachment of the retina. He was thus able to emphasize the work of Professor Gonnin, who undoubtedly was one of the greatest ophthalmic surgeons that had ever lived. Professor Gonnin had revolutionized the treatment of retinal detachment, bringing the lesion from a condition of hopelessness to a stage at which it was possible to expect to cure the vast majority of patients and in selected cases to expect nearly 100% success.

Dr. Gibson then showed a patient who had had a corneal graft from the cadaver. He acknowledged his indebtedness to another great ophthalmic surgeon, Professor Filatov, of Odessa.

Dr. Gibson said that he had no doubt that when the ophthalmic history of the first half of the twentieth century was reviewed, Professor Filatov would rank with Professor Gonnin among the greatest ophthalmic surgeons of the time. He also acknowledged his indebtedness to Professor Filatov for his kindness and courtesy to him (Dr. Gibson).

The patient shown by Dr. Gibson was a woman, aged sixty-four years, who was stone deaf. She was unable to see more than light with either eye, owing to corneal nebulæ and cataracts in both eyes. The right eye had the better cornea, and Dr. Gibson had therefore removed the cataract; the patient was then able to see to read the deaf and dumb alphabet on the fingers and to walk about. Dr. Gibson then decided to try to make the left eye fit to read small print. On his first attempt the patient became hysterical, and he thought that discretion was the better part of valour. On July 13, 1941, he gave her sufficient "Sodium Amytal" to make her calm but cooperative. He followed the technique of Professor Filatov and grafted the cornea from a man, aged thirty years, who had died about twelve hours previously and whose body had been kept at a temperature of 39° F. during the interval. The F.M.2 type of trephines were employed. The size of the trephine for the donor was 4·0 millimetres and that for the recipient 4·05 millimetres. The donor's eye was not enucleated, and it was so arranged that there was very little delay in transferring the graft, and also as little trauma as possible; the graft was not put into any solution during the transfer. Dr. Gibson said that the reason why he did not use the F.M.3 type of trephines was that he had been unable to procure them. It was noted that the graft was quite clear, and when later he removed the cataract there was no reason why she should not read small print with a suitable spectacle lens.

In conclusion, Dr. Gibson drew attention to Professor Filatov's work in skin grafts from the cadaver. He held that they had a beneficial effect on skin lesions such as lupus. It seemed that the time was not far distant when the fashionable old lady would be able to wear the skin of a beautiful young woman.

Plastic Operation to the Nose.

DR. J. R. HUTCHEON showed a woman, aged forty-six years, who seventeen years earlier had undergone a left-sided Caldwell-Luc antrostomy and a submucous resection of her septum. The name of the surgeon concerned had been lost in the mists of time. When she was examined on June 10, 1941, she had a saddle-shaped deformity of her nose from the falling-in of the bridge, and a large septal perforation. Consequently it was decided to perform a plastic operation on her nose to try to restore some of the original shape.

Dr. Hutcheon said that deformities of the nose following septal operations generally fell into one or other of two groups. In the commoner group the septal cartilage had been removed too close to the bridge, the bridge fell in from lack of support, and a saddle-shaped deformity resulted. In the other group removal of cartilage had been carried too close to the columella, and the columella collapsed, the tip of the nose being drawn down. The case under discussion belonged to the first group.

Operation was performed on June 13, 1941. A piece of costal cartilage was removed in the usual way, and then a small transverse incision was made down to and through the periosteum at the fronto-nasal junction. The periosteum and the soft tissues above it were elevated with a blunt dissector to within about one-quarter of an inch from the tip of the nose, and the piece of costal cartilage, with its perichondrium uppermost, was slid down into position along the bridge of the nose. Photographs had been taken to show the nose before and after operation, and Dr. Hutcheon thought that those present would agree that there was a distinct improvement. The scar below the forehead was almost imperceptible.

Dr. Hutcheon went on to say that there were two equally good lines of approach to treatment of the saddle-shaped deformity. The one adopted in the case under discussion used the cantilever method of support, the cartilage being supported along the whole length of the nasal bones and its free end projecting down towards the tip of the nose. In the other method a small incision was made near the anterior end of the columella and the tissues were freed with an elevator to enable the cartilage graft to be slid up till its far end rested on the lower end of the nasal bones, its other end being supported on the cartilage in the columella. In the case under discussion the first method was adopted, because not sufficient cartilage remained in the columella to give firm support to the cartilage graft.

Splanchnicectomy for Primary Hypertension.

DR. ALAN LEE showed a patient suffering from severe primary hypertension, upon whom he had performed a bilateral supradiaphragmatic splanchnicectomy and thoracic sympathetic ganglionectomy. In discussing the development of the surgical treatment of hypertension, Dr. Lee said that the earlier procedures were aimed at controlling a supposed suprarenal factor, and several surgeons, particularly Crile, had performed firstly partial resections of these glands, later denervation, and finally cœliac ganglionectomy. Though these operations occasionally produced a permanent lowering of the blood pressure, the first two were apt to be followed by distressing evidence of suprarenal deficiency. Crile was still performing cœliac ganglionectomy, basing his work on a theory that the suprarenals and cœliac ganglion formed an energy gland, to which primary hypertension bore the relation of a functional over-activity conditioned by the circumstances of modern civilization. Most of the surgical work on hypertension, however, was related to the belief that renal ischæmia was the essential factor in its development. The experimental work of Goldblatt strongly reinforced this belief, and the prevalent view was that in certain persons there was a fault in the renal blood vessels, perhaps akin to the fault in the peripheral circulation in patients who had the Raynaud syndrome, so that minimal cerebral stimulation produced exaggerated and long-continued vasoconstriction. In the ischæmic kidney tissue the production of a toxin was postulated; this produced both the hypertension and the accompanying symptoms of the hypertension. The purpose of surgical treatment, then, was to interrupt the vasoconstrictor fibres to the kidneys. The leaders in this branch of surgery were Smithwick of Boston, Max Peet at Ann Arbor, and Adson at the Mayo Clinic.

The operation performed by Dr. Lee was that of Max Peet, in which, after the removal of a portion of the

eleventh rib on each side, the greater and lesser splanchnic nerves and the thoracic sympathetic chain were extensively removed just above the diaphragm. In the hands of Max Peet about 40% of the patients had a permanent significant lowering of blood pressure, and 85% obtained relief of symptoms. Apparently the more acute and florid the hypertension, and the more clear the spastic element as revealed by retinoscopy, the better the result. In the case under discussion, although there was a primary fall in the systolic blood pressure of over 100 millimetres of mercury, the absence of gross evidence of vasospasm had to be considered an unfavourable feature in the assessment of the permanent result.

Mikulicz's Disease.

DR. KONRAD HIRSCHFELD showed a woman, aged forty-nine years, who in May, 1941, said that for three months she had had a painless swelling of the parotid glands, the swelling on the right side preceding that on the left by some weeks. She was told by the usual well-informed neighbour that she had mumps. She noticed no alteration in the size of the glands during meals. She was not inconvenienced by the swellings, apart from the grotesque appearance that they produced. On examination she was well nourished and seemed reasonably healthy. Both parotid regions were swollen and projected about one and a half inches from the sides of her jaws. There was some fullness of the right submaxillary region. The swellings were elastic, firm and rounded, and a soft edge could be distinguished. On the right side the parotid swelling was continuous with a smaller swelling in the region of the right submaxillary salivary gland; on the left side no such prolongation of the parotid swelling existed. The sublingual glands were not enlarged and the lachrymal glands were not palpable. There was a free flow of saliva and of tears. She had slight ptosis on each side, but in no sense had she the "bloodhound" appearance described by some observers. Slight chronic conjunctivitis of both eyes was present. There were some enlarged lymphatic glands in each axilla, but none were found elsewhere. Neither the liver nor the spleen was palpable, nor were any other clinical signs of disease found. Neither the complement fixation test nor the Wassermann test applied to the blood produced a reaction. A blood count gave the following information: the erythrocytes numbered 4,700,000 per cubic millimetre, the hæmoglobin value was 88% and the colour index was 0·9; the leucocytes numbered 8,000 per cubic millimetre, 64% being neutrophile polymorphonuclear cells, 34% lymphocytes and 2% eosinophile cells. Slight anisocytosis was present. Of the erythrocytes 2% were reticulocytes and the platelets were normal. An X-ray examination of her lungs revealed no abnormality. The patient refused to allow a biopsy of the swellings or of the lymphatic glands and refused to allow a sialogram to be made. She had been under observation for four months, and during that time had been taking large doses of potassium iodide (up to 150 grains per day). The swellings were slightly smaller, though she thought that they were now barely noticeable, and it was for this reason that she refused further investigation and radiation therapy.

Dr. Hirschfeld said that bilateral enlargement of the parotid glands occurred in mumps, in acute suppurative parotitis, in bilateral tumours, and in a group of cases in which a painless symmetrical enlargement occurred; this constituted Mikulicz's disease or syndrome. Mumps and acute suppurative parotitis could be excluded in this case by the course of the disease and by the absence of pain and of the signs of inflammation. The absence of lobulation and the diminution in the size of the swellings in four months were against the diagnosis of tumours, as was the enlargement of the submaxillary salivary gland, for while tumours of both parotid glands were possible, a simultaneous tumour of the submaxillary gland was hardly probable. The remaining enlargements of the parotids, as Thursfield had pointed out in 1914, could be classified into eight groups: (i) a congenital, hereditary or familial affection; (ii) Mikulicz's disease proper; (iii) Mikulicz's disease with enlargement of the lymphatic glands (all three of these groups had in common the fact that no other disease could be found; in the other groups another disease was present, which was believed to be the cause of the enlargement); (iv) uveo-parotid tuberculosis; (v) syphilis; (vi) lymphatic leuchæmia; (vii) gout; (viii) lymphosarcoma. This subdivision, in which there was an accompanying disease, was Mikulicz's syndrome. In the case under discussion the normal X-ray appearances of the lungs, the absence of a Wassermann reaction, the normal blood picture, the absence of other signs of gout and the absence of enlargement of the liver and spleen indicated that the diagnosis was Mikulicz's disease with enlargement of the lymphatic glands. All the salivary and lachrymal glands might be affected, or only some of them. When the lachrymal glands were affected as well as the parotids, the bulging of the outer half of the upper eyelid, together with the heavy jowls produced by the parotid swellings, gave the patient a distinct resemblance to a bloodhound. Histological examination of the glands disclosed a round-celled infiltration of the tissues, which was considered by Mikulicz to be the response to a low-grade chronic infection. The prognosis was good, as the swellings, which were the only disability, seemed to disappear in about five years. Excellent results had recently been obtained by the use of radiation therapy. Iodides had also some good effect. It had been noted on several occasions that the swellings retrogressed if an acute bacterial infection, such as erysipelas or pneumonia, should occur. This suggested that the enlargement was in some way related to the response of the lymphatic system to an infection.

Medical Practice.

A NEW SOUTH WALES PROTECTION OF PRACTICES SCHEME.

THE following information on the protection of practices scheme which has been operating since June, 1940, in the eastern suburbs of Sydney is published at the request of the committee of the Eastern Suburbs Medical Association.

The scheme began to operate on June 1, 1940. Of the one hundred and twenty medical practitioners in the Eastern Suburbs, seventy-eight participated. The method of contribution is a unit one, the amount of £2 5s. being contributed each quarter by each individual for each absentee.

The yearly balance sheet of the year ending June 30, 1941, was audited by the firm of Coates, Cunningham and Stiffe, and showed a creditable statement.

A summary of the financial transactions during the year is as follows:

	£	s.	d.
Contributions received	3,569	4	6
Interest credited	8	14	4
	3,577	18	10
Less payments to absentees	3,211	0	0
Less sundry disbursements, postage, stationery *et cetera*	11	14	4
Balance at June 30	355	4	6

During that year there were ten absentee practitioners who received financial benefit under the scheme.

There were six members who undertook full-time war service but did not call on the scheme for benefits.

It is interesting to note that the total cost of administration of this sum of three and one-half thousand pounds was only eleven pounds odd. This was undoubtedly due to the generous services of the British Medical Agency of New South Wales.

The scheme is at present assisting thirteen absentees and is functioning adequately.

SUBSIDISED MEDICAL SERVICES IN VICTORIA.

THE Medical Secretary of the Victorian Branch of the British Medical Association writes that advice has been received from the Secretary to the Premier's Department that the Victorian Government is prepared to pay subsidies of £300 *per annum* to medical practitioners willing to practise in Werrimull, Quambatook and Walwa.

Post-Graduate Work.

RESIDENTIAL COURSE IN OBSTETRICS AT SYDNEY.

THE New South Wales Post-Graduate Committee in Medicine will hold a residential course in obstetrics at the Women's Hospital, Crown Street, Sydney, from January 4 to 10, 1942. Registrations for the course will be limited to five persons, and the closing date for application to attend is December 22, 1941. The programme is as follows.

Sunday, January 4.—10.30 a.m.: Introduction and explanation of course; film on abdominal palpation. 2.30 p.m.: The care and feeding of infants.

Monday, January 5.—Morning: Rounds of hospital with superintendent; clinical pathology and biochemistry as applied to obstetrics. Afternoon: Diagnosis and treatment of disproportion.

Tuesday, January 6.—Morning: Indication for the application of forceps and demonstration. Afternoon: Demonstration of X-ray films.

Wednesday, January 7.—Morning: Treatment of hæmorrhage in the last three months of pregnancy. Afternoon: The diagnosis and treatment of persistent occipito-posterior presentation.

Thursday, January 8.—Morning: Toxæmia of pregnancy. Afternoon: Medical complications associated with pregnancy.

Friday, January 9.—Morning: Diagnosis and treatment of breech presentation. Afternoon: Film on physiotherapy in pregnancy and the puerperium.

Saturday, January 10.—Morning: Résumé of investigation, diagnosis and treatment of puerperal sepsis.

The fee for the course is five guineas, and applications for registration, accompanied by a remittance for the amount of the fee, must be made before December 22, 1941, to the Secretary, New South Wales Post-Graduate Committee in Medicine, the Prince Henry Hospital, Little Bay.

Correspondence.

A GENERAL MEDICAL SERVICE FOR AUSTRALIA.

SIR: The Federal Council's "plan" for a national medical service as published in your journal on November 1 shows that a large amount of time and thought has been put into this matter. Unfortunately even before the profession had a chance to consider this plan extracts from it were allowed to be published in the lay Press, and when it is carefully considered it is probably doubtful if it would be acceptable to the profession as a whole, and the following defects become apparent immediately.

1. The practice of medicine would become controlled, and no matter what safeguards were provided we would still be responsible to a third party in the relation to our patients and in the conduct of our professional lives.
2. No provision is made for regular hours of work.
3. Holidays and sick leave are not provided for.
4. Superannuation or retiring allowances at a certain age or on account of ill health are unprovided for.
5. No provision is made for all the many expenses of running a medical service, such as the provision of consulting rooms, attendance, instruments, car, telephone, drugs, dressings *et cetera*.

In other words, we would become public servants, practically if not in name, and consequently be subjected to all kinds of rules and regulations; but at the same time we would not be granted any of the privileges of the public service.

There are still a number of men on the Federal Council who accepted the previous national health insurance scheme in 1938, even though it appeared at the time that the scheme was absolutely unacceptable to the majority of the profession, and the same council now advances a similar scheme based on a *per capita* basis without even firstly ascertaining the views of the rank and file of the profession or even considering any alternative scheme, such as that put forward by the Victorian Branch! Again, the majority of members of the Federal Council are senior men in specialist practice, with a large proportion of their professional lives behind them, and if this council is the body that will ultimately accept any final scheme under which we will in future conduct our professional lives, it is time that a number of its members made way for younger men, who will naturally be much more vitally interested in the future conditions under which we are to work.

I would like to suggest that subcommittees of younger practitioners should be immediately appointed to consider other schemes, such as:

1. One that will grant at least the conditions of the Commonwealth health service, under which we would require a salary ranging up to £1,750 or more *per annum*, all the necessary equipment, consulting rooms and attendance provided, holidays, regular hours of work, superannuation *et cetera* to be added. Such a scheme would not cause a levelling down of present standards, but on the other hand would give much more time to do good work and to keep up with modern trends.

2. A plan under which payment is to be made for services rendered, the individual payments under this to be enough for practitioners to maintain their present status in the community.

It seems that there can be little doubt that we will be forced to accept changed conditions in a changing world, and it is only by proper organization now and thorough investigation of any scheme or schemes that we will, in the future, be able to give the community the best possible service and at the same time maintain our own professional status and privileges.

Yours, etc.,
R. H. OXBY DONALD.

11, Mostyn Street,
Castlemaine,
Victoria.
November 8, 1941.

SIR: In your editorial of November 1 you had occasion to record that the Federal Council of our Association, at its meeting in September, decided not to discuss a suggestion for a salaried national medical service. And you commented that: "This decision was a pity." Will you allow me to echo that comment and to emphasize it? Such a decision in such circumstances was more than a pity. It gives grounds for grave disquiet as to the quality of our official leadership.

The circumstances in which the council met were essentially suitable to such discussion. They had before them a report by two of their members outlining a general medical service for Australia, based on the principle of capitation fee and income limit. They had also before them another report from an official body of authoritative weight, and composed largely of medical men, in which the principle of the capitation fee as a basis for a national medical reorganization was gravely and logically criticized. Further, there has been for the past year or so a fair volume of correspondence in your columns giving evidence that some at least of the members of our profession think the salaried principle worthy of consideration. In every issue of *The British Medical Journal* there is abundant evidence of the same feeling among the members of the Parent Association. Close to us, in our sister Dominion of New Zealand, a state of things has arisen which should surely make us anxious to have our own position as sound as possible. I understand, too, that a letter had been sent from the council of one of the Australian Branches, asking that the Federal Council should take no steps to implement the report they had before them, until they had first examined the principles of a salaried national scheme. And finally, to facilitate such consideration, the council of the Victorian Branch had appointed a subcommittee to draft a sample proposal for a salaried service and sent it by their representatives to the Federal Council meeting.

If, in these circumstances, serious and open discussion of the alternative form of medical reorganization had taken place—even if it had required a special meeting for the purpose—and the capitation fee principle had then been adopted, many of us might have doubted the wisdom of the decision, but none could have questioned the procedure. But when, in these circumstances, all discussion of the alternative principle was simply refused, one's feeling is very different, and criticism of the attitude and action of the Federal Council is difficult to avoid.

Now, I presume, the report as adopted will be sent to the councils of the various Branches, for their acceptance, amendment or rejection. I trust that at the meetings of these councils scope will be given for at least full consideration and discussion of alternatives. I consider this most important for the two following reasons.

First: it is not the tailors who decide what clothes the public will wear, but the public who wear them. So long as the clothes supplied are good and reasonable the public allow the tailors great latitude in dictating fashion and design. But should they not get within bounds what they require they will apply economic pressure which will be effective. It is not the railwaymen who decide, in the long run, what service the railways shall give the community, but the public who need and use the railways. Within a reasonably wide latitude the railways personnel are allowed to manage the railways in the light of their expert knowledge; but should the service fall too far short of the public needs, political pressure will be brought to bear and the staff will be reorganized from top to bottom so that the services shall be brought into conformity with what the public want. And it is not the British Medical Association nor the members of the medical profession who have the ultimate decision as to the supply of medical and, even more,

health services to the community. I need not draw the parallel any further. It is not conceivable that we should refuse to hold the public need in mind in drawing up plans for future medical and health organization.

And second: the greatest single obstacle in the way of effective reorganization of medical and health services is the vested financial interest we doctors have in the treatment of sickness. That may seem a hard saying; but can any thoughtful man declare it is not true? It is a result of traditional development and customary evolution, and it is nothing that we need be ashamed of as regards the past or the present. But it is something that we must recognize and openly discuss if we are to avoid the risk of having to be ashamed of it in the future. Consider the current medical problems. The employment of alien refugee doctors. I know there are good arguments against this; I have used them myself. But they would have much less weight if it were not for the basic argument underlying them, that these men may step in and take away the assets and livelihood of the men who have left their practices to go to the war. Look at the problems the various Branches had to face when so many men left civil life for service overseas. Not the proper distribution of those who were left, but the "protection of practices" of those who went. Would any redistribution of the men remaining be possible in our present financial framework? Consider the implications of the recommendations set out in Part I of the report of the National Health and Medical Research Council, for a large extension of public health services by salaried men; and see the inevitable financial conflict which must ensue. Look honestly and fearlessly at any possible future development of public health services and see if they do not directly menace the financial interests of doctors in private practice?

For those two reasons I consider the Federal Council's action in refusing to consider all possible reasonable forms of future medical organization and development as gravely unfortunate; and I sincerely trust that the Branch councils in their turn will not make the same mistake.

If, after free discussion, and in full knowledge of the fact that the service must be organized not as we personally desire, but as the public need demands, and of the fact too that our own vested interests do present an obstacle to proper distribution and organization of the country's medical services, the Branches then decide on the capitation-fee-*plus*-income limit as an ideal basis for medical organization, many men will regret the decision, but will not cavil at the procedure. Democracy can accept a majority opinion, provided it is based on full discussion of all known relevant facts. It cannot, and should not, accept such an opinion in which these facts have not been faced.

We cannot fight honestly to force an inefficient service on the public because we ourselves like better working under the conditions it provides. We can honestly accept any truly effective service and devote our energies to removing any unjust or unpleasant aspects of it during our working of it.

Yours, etc.,

ARTHUR E. BROWN.

Colac,
Victoria,
November 16, 1941.

SIR: The letter of Dr. H. R. R. Grieve appearing in THE MEDICAL JOURNAL OF AUSTRALIA of November 15, 1941, is no doubt designedly provocative, and for this reason is to be welcomed at a time when it is necessary that members' opinions should be freely expressed. It is to be hoped, however, that those whose point of view may differ from his will not keep silence. If it be true that the Federal Council does not know what the profession wants, now is the time to let it know, as clearly as possible, both what the majority and the minorities want.

The future of medicine in Australia depends, of course, not only on what the doctors would like, but also on what the people have a right to demand of them. This right is nothing less than adequate medical care in sickness and in health. Notwithstanding the alleged efficiency of our existing medical organization, the overflowing hospitals and tremendous invalid pensions list, among other things, indicate how far from adequate that organization has been.

It has been estimated that at least one death out of every three could have been prevented or postponed. Does not Dr. Grieve's five-point national health programme of things we still lack point the moral that medical and social organization for health has been inadequate and therefore must be improved?

One might ask where Dr. Grieve's government medical officers who have never practised medicine are to be found. Could it be that some of them have revolted against a "Dick Turpin" standard of medical ethics which permits exploitation of the wealthier so that charity may be given to the poor? Is it possible that, whilst being paid by the people, as our judges, our soldiers, our Prime Minister are paid, one may practise one's profession according to its highest ideals, placing service before pecuniary reward? The poor, it is safe to say, do not want our charity, but just as certainly they need our help.

The Federal Council's scheme and the National Health and Medical Research Council's plan, it appears, have many points in common. At least they form a basis for further study. Collectively, by virtue of our training and experience, we should know more of the health needs of the people than laymen can know. Assuming that no radical alteration in the existing system of medical service will be made during the war, we have still a little time to acquire what seems to be urgently needed—a better understanding of each other's point of view. Having done so, and not till then, we can serve the public welfare, as well as our own, by formulating what Dr. A. E. Brown has called "a complete and concrete plan which will forestall less well-instructed attempts".

I for one hope to hear at association meetings, and to see in the pages of our journal a great deal more from my colleagues before I shall feel satisfied that the problem of planning to secure the best possible service has been solved.

Yours, etc.,

H. G. WALLACE.

Sydney,
November 18, 1941.

THE PAD IN THE ARMPIT FOR FRACTURED CLAVICLE: A CONDEMNATION.

SIR: The Saint John Ambulance Handbook advises the use of a pad two inches by two inches by four inches to be placed in the armpit and used as a fulcrum by a broad bandage round the elbow and trunk; it adds: "Ascertain if the pulse is present at the wrist; if not, relax the bandage round the body."

I submit that such advice is highly dangerous; if enthusiastically applied, perhaps even with a hard object to achieve real leverage, the brachial artery is almost certain to be obliterated, and the first-aider, under stress, is likely to forget to test the pulse, or he may rely on watching the colour come and go in the fingers (the fallacy of which I have previously pointed out), and in any case it is still unsafe.

It may be added that the effect of such leverage on the collarbone is more than doubtful, as in practice the movement of the shoulder required is up and back.

Finally, simple, effective first aid can be performed quite well without the pad, so why take a chance?

It is urged that all first-aid teachers preach this condemnation without fear of "the book".

Yours, etc.,

CRAWFORD MCKELLAR.

143, Macquarie Street,
Sydney,
November 10, 1941.

MODERN METHODS IN THE DIAGNOSIS OF TUBERCULOSIS.

SIR: Amongst the many interesting remarks made by Dr. James in the discussion on tuberculosis in the October 25 issue of your journal, he makes the following statement: "A fair proportion of the patients sent to the bureau were suffering from chronic sinusitis and associated bronchitis. A noticeable feature of many such cases was that an anxiety state was frequently present as well—much more so than in the cases of actual pulmonary tuberculosis" *et cetera*. This remark of Dr. James is of great significance and helps to focus our attention on the relationship of focal infections and this condition. Unfortunately, for some reason sinus infection is given scant attention by the majority of medical men. Whilst doing out-patient work at Saint Vincent's Hospital I found 25% of patients with this infection. It is not easy to say why sinus infection, more so than other infections, tends to the anxiety state, which is seen in its most marked form in toxic goitre and often associated without thyreoid enlargement; but undue stimulation of the cervical ganglia may be a factor or there may even be direct invasion of the meninges and cerebral tissue by low-grade organisms. A year or so ago I believe it was Dr. Vines drew attention to the association of sinus infection and insanity in *The British Medical Journal*. He showed how in many of these cases there was locked up pus in the cells and there was every suggestion that direct invasion of the

cerebral tissue had taken place. In *The British Medical Journal*, August 13, 1935, page 800, there is reference to the relationship of epilepsy and sinus infection. I am at the present time treating a woman who is suffering from epilepsy which started late in life, the onset of which, as far as she can recall, coincides with her sinus trouble. Within the last few days I have seen a school teacher with the anxiety state and sinus infection, who after a fortnight's treatment has lost his sinusitis and anxiety. Another case was a bank official who had served in the last war and has been treated ever since for war neurosis and is in a bad way. He has been under treatment by various men, but not one, in spite of violent headaches, has investigated his nasal condition.

Dr. James, by drawing attention to this point, may encourage others to give greater attention to the sinuses as a source of neurosis and infection.

Yours, etc.,

SYDNEY PERN.

Ballarat,
Victoria,
November 11, 1941.

PROBLEMS IN THE THERAPY OF ULCERATIVE GRANULOMA.

SIR: Dr. Earle suggests that this disease is likely to appear in this country in the near future (THE MEDICAL JOURNAL OF AUSTRALIA, November 15, 1941). It has been endemic in the north of Australia for many years. For the most part it occurs in bush natives, who live in that state of bliss so ardently praised by some anthropologists, and known as the tribal.

It shows no tendency to spread to communities that have an elementary knowledge of hygiene, are better nourished and can benefit from the help medical science can give.

Although the disease is generally classed as venereal, there is a possibility that young children are infected indirectly, most probably by sitting naked on infected ground, as the original site of infection is often the moist folds of the perineum. Professor Cleland has put forward the idea that tribal dogs can carry the infection. In support of this contention, Mr. W. Mackenzie, of Aurukun Mission, Cape York Peninsula, informed me that he had seen a bitch that was badly infected.

The introduction of an antimony salt that can be given intramuscularly, as described by Dr. Earle, has proved of great value. Formerly it was necessary for all patients to travel hundreds of miles to Thursday Island to receive intravenous medication, whereas they now are given intramuscular injections by lay workers on several of the missions.

The preparation used for some years is "Anthiomaline" (lithium antimony thiomalate), put up by May and Baker.

Active treatment must be maintained for some weeks, and until the scar tissue is dry and healthy. As most of the tribal patients are suffering from malnutrition and a lowered resistance due to untreated malaria, yaws and perhaps hookworm, a full diet, rich in vitamins, is essential during treatment.

Yours, etc.,

JOHN R. NIMMO.

Duntroon,
Australian Capital Territory,
November 17, 1941.

COLOUR BLINDNESS.

SIR: The letter of Dr. Lethbridge relating to colour blindness is full of interest.

A colour-blind person often manages correctly by employing various adventitious aids.

I have had two remarkable instances. A first officer, twenty-eight years of age, in the mercantile marine had a successful career until three days before I saw him. He then, in charge of a ship, had nothing but colour to guide him and would have wrecked the ship but for the action of the captain. He was a most capable man and knew, apart from colour, what the movements of ships meant, and the captain told me that up to this action he never suspected anything wrong.

The second instance was that of a most distinguished colleague, a physician, who was grossly red blind. He was investigated on three Saturday afternoons by Sir Charles Martin and myself, and at the end of the last session it was difficult to catch him. For example, a red letter on a black ground he detected by the reflection from the varnish *et cetera*.

I suggest that Dr. Lethbridge test his patient in a dark room after several minutes with an Edridge Green or similar lantern. There can then be no adventitious aid and no test except colour. Furthermore there is often partial colour blindness, not the classical form, and that may want investigation by a physicist.

If Dalton, who discovered colour blindness, had been born a few centuries ago we should have employed white lights of different shapes and possibly in some places blue and yellow. Red and green blindness affects 6% to 8% of males and a fraction of 1% in females. But anyone who fails with the Ishihara test is not safe. If they are tested with Ishihara through a red glass they usually read correctly.

Yours, etc.,

JAMES W. BARRETT.

103-105, Collins Street,
Melbourne, C.1,
November 18, 1941.

Naval, Military and Air Force.

APPOINTMENTS.

THE undermentioned appointments, changes *et cetera* have been promulgated in the *Commonwealth of Australia Gazette*, Number 226, of November 13, 1941.

PERMANENT NAVAL FORCES OF THE COMMONWEALTH (SEA-GOING FORCES).

Appointments.—Surgeon Commander (Acting Surgeon Captain) Alexander Scott Mackenzie is appointed Honorary Physician to His Excellency the Governor-General; Surgeon Commander (Acting Surgeon Captain) David Shields Prentice is appointed Honorary Surgeon to His Excellency the Governor-General.

AUSTRALIAN IMPERIAL FORCE.

Australian Army Medical Corps.

The undermentioned officers are transferred from Reinforcements from the dates shown: Captains T. Godlee, 5th July, 1941, F. R. Magarey, H. R. T. Hodgkinson, V. E. Sampson, E. W. Sibree, M. J. McNamara, J. K. Gardner, R. A. Isenstein, M. S. Truscott, A. E. Lincoln, C. W. Taylor, J. H. Johnston, M. G. F. Donnan, R. G. Lyne, H. B. Hattam, D. R. Gauld, R. F. A. Strang and J. R. O. Roger, 27th June, 1941.

Permanent Supernumerary List.

The undermentioned officers are transferred from the Australian Army Medical Corps from the dates shown: Major H. M. De Burgh, 8th August, 1941, and Captain F. E. Gallash, 20th August, 1941.

AUSTRALIAN MILITARY FORCES.

AUSTRALIAN ARMY MEDICAL CORPS.

Seventh Military District.

Lieutenant-Colonel (Honorary Colonel) E. Culpin is appointed from the Reserve of Officers (A.A.M.C.), 1st Military District, to command a General Hospital and is granted the temporary rank of Colonel, 2nd October, 1941.

Northern Command.

First Military District.

Major L. B. Elwell, M.C., is appointed from the Reserve of Officers (A.A.M.C.) with regimental seniority next after Major N. W. Markwell, 9th September, 1941.

The following officers are appointed from the Reserve of Officers (A.A.M.C.): Honorary Captains R. Grant, P. W. Hopkins, M.C., and W. E. Hasker, and to be Captains (provisionally), 2nd January, 1941; Captain F. W. R. Lukin, 13th January, 1941; Honorary Captains B. J. Butcher and E. N. Kurrle, and to be Captains (provisionally), 13th January, 1941; Honorary Captains S. E. Warriner and L. Morris, and to be Captains (provisionally), 20th January, 1941, and 29th April, respectively; Honorary Captain J. H. Blackburn, with regimental seniority next after Captain (provisionally) G. M. Redshaw, and to be Captain (provisionally), 24th September, 1941; Captain R. P. Rundle, with regimental seniority next after Captain T. V. Stubbs-Brown, 24th September, 1941; Honorary Captain J. J. Fitzwater, and to be Captain (provisionally) with regimental seniority next after Captain (provisionally) J. H. Blackburn, 29th October, 1941; and Honorary Captain N. J. O'Connor, and to be Captain (provisionally) with regimental seniority next after Captain (provisionally) J. J. Fitzwater, 10th November, 1941.

To be Captain (provisionally).—Patrick James Kelly, 3rd October, 1941.

To be Honorary Captains.—Paul Wanostrocht Mitchell, 29th September, 1941, Patrick Augustine Foley, 6th October, 1941, and Rowe Clyde Dent, 8th October, 1941.

Eastern Command.

Second Military District.

Honorary Captains J. L. Watt and W. A. L. H. Henderson are appointed from the Reserve of Officers (A.A.M.C.) and to be Captains (provisionally), 30th September, 1941.

The provisional appointment of Captain R. Huntley is confirmed.

The resignation of Captain (provisionally) W. T. H. Scales of his commission is accepted, 26th September, 1941.

Captain (provisionally) N. R. Paterson is retired, 29th September, 1941.

To be Lieutenant-Colonel (temporarily).—Captain (Temporary Major) J. R. Shannon, 16th September, 1941.

To be Captains (provisionally).—Leo Hanney McMahon, 30th September, 1941, and Thomas Sydney Punch, 9th October, 1941.

The resignation of Honorary Captain S. Shineberg of his commission is accepted, 22nd September, 1941.

To be Honorary Captains.—George Moncrieff Barron, 18th September, 1941, Edward Patrick Armstrong, 29th September, 1941, Ronald Louis Spedding, 30th September, 1941, Alexander Allan Palmer, 3rd October, 1941, Frank Leslie Utber and Edward William Stout, 6th October, 1941.

Honorary Captain M. H. Thomas is appointed from the Reserve of Officers (A.A.M.C.), 3rd Military District, and to be Captain (provisionally), 2nd October, 1941.

The following officers are appointed from the Reserve of Officers (A.A.M.C.) on the dates shown: Honorary Captains B. F. Hindmarsh, 19th September, 1941; and N280568 F. J. McEnroe, 22nd September, 1941; and to be Captains (provisionally); and Honorary Major J. W. Van R. Hoets and to be Major (provisionally), 9th October, 1941.

The notification respecting the appointment of Major (now Temporary Colonel) W. Evans, M.C., which appeared in Executive Minute No. 177/1941, promulgated in *Commonwealth Gazette* No. 197 of 1941, is cancelled.

The notification respecting the appointment of Honorary Captain J. L. Watt, which appeared in Executive Minute No. 94/1940, promulgated in *Commonwealth Gazette* No. 88 of 1940, is cancelled.

To be Honorary Captains.—Reginald Ernest Wherrett, 10th October, 1941; Nugent Elliot Brand and Owen Upcott Williams, 13th October, 1941.

Southern Command.

Third Military District.

The name "K. G. Brown" appearing in Executive Minute No. 177/1941, promulgated in *Commonwealth Gazette* No. 197 of 1941, is amended to read "K. B. Brown".

Captain (provisionaly) (now Temporary Major) C. W. Ross is seconded, 1st March, 1940.

To be Lieutenant-Colonel (temporarily) and remains seconded.—Captain (provisionally) (Temporary Major) C. W. Ross, 1st September, 1941.

To be Captains (provisionally).—Frederick Thomas Rose, John Henry Lindell, Blair Widmer, Stanislaus Joseph O'Loughlin, Colin Russell Copland, William Marc Ket, Alastair Heriat Campbell, Winston Sullivan Smith, Graeme Foster Salter, Edward Patrick Hennessy and John Maurice Barrett, 29th September, 1941.

To be Honorary Captains.—Francis Catarinich, Leslie Kirsner, Neil Furphy Pescott, Robert Leonard Hodge, Norman Cornelius Lee Tet, Lloyd Owen Morgan, Colin Robert Laing, Cyril Harcourt Chambers and Orme Kaye Kewish, 29th September, 1941.

Captain (Temporary Major) H. I. Gibb relinquishes the temporary rank of Major and is transferred to the Reserve of Officers (A.A.M.C.), 10th October, 1941.

Honorary Major P. MacCallum, M.C., is appointed from the Reserve of Officers (A.A.M.C.), to Major (provisionally) and is seconded and to be Lieutenant-Colonel (temporarily) and remains seconded, 29th September, 1941.

To be Captain (provisionally).—William Samuel Benwell, 14th October, 1941.

Western Command.

Fifth Military District.

Honorary Captain W8 T. Godlee is appointed from the Reserve of Officers (A.A.M.C.) and to be Captain (provisionally), 22nd July, 1940 (in lieu of the notification respecting this officer which appeared in Executive Minute No. 49/1941, promulgated in *Commonwealth Gazette* No. 50 of 1941).

To be Captain (provisionally).—W38342 James Edward McMahon, 3rd October, 1941.

DECORATIONS.

CAPTAIN Edmund James Cairns Molesworth, of Sydney, New South Wales, has been awarded the Military Cross.

MEDICAL WAR RELIEF FUND.

THE following is a twenty-first list of contributions to the Medical War Relief Fund established by the Federal Council of the British Medical Association in Australia for the relief of distressed medical practitioners in Great Britain.

New South Wales.

£5 5s.: Dr. A. G. Brydon, Dr. W. O. Pye, Dr. H. R. Mallam.
£5: Dr. W. R. Beavis.
£3 3s.: Dr. T. S. Douglas, Dr. J. Kerr.
£2 2s.: Dr. H. C. Barry, Dr. A. J. Corfe, Dr. R. W. H. Maffey, Dr. H. S. Marsh, Dr. G. S. Abbott, Dr. C. M. O'Halloran, Dr. A. S. D. Studdy, Dr. C. H. Jaede.
£2: Dr. W. R. Beeston.
£1 1s.: Dr. H. G. D. Cookson, Dr. K. J. B. Davis (second contribution), Dr. I. H. Mackay, Dr. A. J. Newton, Dr. J. R. Barriskill, Dr. R. L. Douglas.

Queensland.

£2 2s.: Dr. W. F. Machin.

Research.

THE WILLIAM GIBSON RESEARCH SCHOLARSHIP FOR MEDICAL WOMEN.

MISS MAUD MARGARET GIBSON has placed in the hands of the Royal Society of Medicine a sum of money sufficient to provide a scholarship of the yearly value of £220, in memory of her father, the late Mr. William Gibson, of Melbourne, Australia. The scholarship is awarded from time to time by the society to qualified medical women who are subjects of the British Empire, and is tenable for a period of two years, but may in special circumstances be extended to a third year. The next award will be made in July, 1942.

In choosing a scholar the society will be guided in its choice either by research work already done by her or by research work which she contemplates. The scholar shall be free to travel at her own will for the purpose of the research she has undertaken.

There is no competitive examination, nor need a thesis or other work for publication or otherwise be submitted. The society has power at any time to terminate the grant if it has reason to be dissatisfied with the work or conduct of the scholar.

Applications should be accompanied by a statement of professional training, degrees or diplomas, and of appointments, together with a schedule of the proposed research. Applications must be accompanied by testimonials, one as to academical or professional status and one as to general character. Envelopes containing applications *et cetera* should be marked on top left-hand corner "William Gibson Research Scholarship", and should be addressed to Mr. G. R. Edwards, Secretary, Royal Society of Medicine, 1, Wimpole Street, London, W.1, and be received not later than Monday, June 1, 1942.

Australian Medical Board Proceedings.

TASMANIA.

THE undermentioned have been registered, pursuant to the provisions of the *Medical Act*, 1918, of Tasmania, as duly qualified medical practitioners:

McOmish, Daniel Ross Arnott, M.B., B.S., 1940 (Univ. Melbourne), Latrobe.
Tippett, Dorothy Lilian, M.B., B.S., 1941 (Univ. Melbourne), Burnie.
McGrath, John Vincent, M.B., B.S., 1941 (Univ. Melbourne), Royal Hobart Hospital, Hobart.
Bird, Peter James, M.B., B.S., 1941 (Univ. Melbourne), Royal Hobart Hospital, Hobart.
Costello, Brian Walle, M.B., B.S., 1941 (Univ. Melbourne), Royal Hobart Hospital, Hobart.
Hede, John Allen, M.B., B.S., 1941 (Univ. Melbourne), Royal Hobart Hospital, Hobart.

Rail, Wilton Whitburne, M.B., B.S., 1941 (Univ. Melbourne), Royal Hobart Hospital, Hobart.
Ryan, Ellery Arthur Mulvihill, M.B., B.S., 1941 (Univ. Melbourne), Royal Hobart Hospital, Hobart.
Jamieson, Thomas John Knox, M.B., B.S., 1941 (Univ. Melbourne), Royal Hobart Hospital, Hobart.
Cahill, Arthur James, M.B., 1903, Ch.B., 1904 (Univ. Melbourne), Public Health Department, Hobart.
Worcester, Alan, M.B., B.S., 1941 (Univ. Melbourne), Royal Hobart Hospital, Hobart.
Robertson, David Blair, M.B., B.S., 1940 (Univ. Melbourne), Burnie.
Wilson, Lachlan Hardy, M.B., B.S., 1941 (Univ. Melbourne), Launceston Public Hospital, Launceston.
Simpson, John George, M.B., B.S., 1941 (Univ. Melbourne), Launceston Public Hospital, Launceston.
Churston, David Philip, M.B., B.S., 1941 (Univ. Melbourne), Launceston Public Hospital, Launceston.

SOUTH AUSTRALIA.

THE undermentioned have been registered, pursuant to the provisions of the *Medical Practitioners Act*, 1919 *to* 1935, of South Australia, as duly qualified medical practitioners:

Rodriguez, Phyllis Edna, L.M.S., 1937 (Singapore), Port Lincoln.
Gorman, John Lawrence, M.B., B.S., 1936 (Univ. Melbourne), Parkside Mental Hospital, Parkside.

Obituary.

HENRY GERALD LOUGHRAN.

WE regret to announce the death of Dr. Henry Gerald Loughran, which occurred on November 18, 1941, at Kyneton, Victoria.

WILLIAM CLAIR LEONARD MALONE.

WE regret to announce the death of Dr. William Clair Leonard Malone, which occurred on November 23, at Vaucluse, New South Wales.

Nominations and Elections.

THE undermentioned have applied for election as members of the New South Wales Branch of the British Medical Association:

McMeekin, Hedley James Parker, M.B., B.S., 1940 (Univ. Melbourne), Broken Hill and District Hospital, Broken Hill.
Holmes, Roland Adrian Glennie, M.B., B.S., 1941 (Univ. Sydney), Royal Prince Alfred Hospital, Camperdown.
Macleod, Kenneth William, M.B., 1941 (Univ. Sydney), Royal North Shore Hospital, St. Leonards.
Klineberg, David, M.B., 1936 (Univ. Sydney), 56, Old South Head Road, Vaucluse.

The undermentioned has applied for election as a member of the South Australian Branch of the British Medical Association:

Taylor, Robert Bromley, M.B., B.S., 1941 (Univ. Adelaide), Royal Adelaide Hospital, Adelaide.

The undermentioned has been elected a member of the South Australian Branch of the British Medical Association:

Goode, Phillip Charles Ryall, M.B., B.S., 1941 (Univ. Adelaide), Royal Adelaide Hospital, Adelaide.

Medical Appointments.

Dr. Arthur Cecil Moran has been appointed Government Medical Officer at Wagga Wagga, New South Wales.

Dr. Kenneth Joseph Gilmore Wilson, pursuant to the provisions of *The Medical Acts*, 1939 *to* 1940, of Queensland, has been appointed a Member of the Medical Board of Queensland.

Books Received.

"Surgery of Modern Warfare", edited by H. Bailey, F.R.C.S.; Part V; 1941. Edinburgh: E. and S. Livingstone. Super royal 8vo, pp. 235, with illustrations and diagrams. Price: 17s. 6d. net.

"Diseases of the Nervous System Described for Practitioners and Students", by F. M. R. Walshe, O.B.E., M.D., D.Sc., F.R.C.P.; Second Edition; 1941. Edinburgh: E. and S. Livingstone. Demy 8vo, pp. 341, with illustrations and diagrams. Price: 12s. 6d. net.

"Essentials for Final Examinations in Medicine", by J. De Swiet, M.D., M.R.C.P.; 1941. London: J. and A. Churchill Limited. Crown 8vo, pp. 176. Price: 7s. 6d. net.

Diary for the Month.

DEC. 3.—Western Australian Branch, B.M.A.: Council.
DEC. 3.—Victorian Branch, B.M.A.: Annual Meeting.
DEC. 3.—Victorian Branch, B.M.A.: Council.
DEC. 4.—South Australian Branch, B.M.A.: Council.
DEC. 9.—Tasmanian Branch, B.M.A.: Branch.
DEC. 11.—New South Wales Branch, B.M.A.: Branch.
DEC. 12.—Queensland Branch, B.M.A.: Annual Meeting.
DEC. 17.—Western Australian Branch, B.M.A.: Branch.
DEC. 19.—Queensland Branch, B.M.A.: Council.

Medical Appointments: Important Notice.

MEDICAL PRACTITIONERS are requested not to apply for any appointment mentioned below without having first communicated with the Honorary Secretary of the Branch concerned, or with the Medical Secretary of the British Medical Association, Tavistock Square, London, W.C.1.

New South Wales Branch (Honorary Secretary, 135, Macquarie Street, Sydney): Australian Natives' Association; Ashfield and District United Friendly Societies' Dispensary; Balmain United Friendly Societies' Dispensary; Leichhardt and Petersham United Friendly Societies' Dispensary; Manchester Unity Medical and Dispensing Institute, Oxford Street, Sydney; North Sydney Friendly Societies' Dispensary Limited; People's Prudential Assurance Company Limited; Phœnix Mutual Provident Society.

Victorian Branch (Honorary Secretary, Medical Society Hall, East Melbourne): Associated Medical Services Limited; all Institutes or Medical Dispensaries; Australian Prudential Association, Proprietary, Limited; Federated Mutual Medical Benefit Society; Mutual National Provident Club; National Provident Association; Hospital or other appointments outside Victoria.

Queensland Branch (Honorary Secretary, B.M.A. House, 225, Wickham Terrace, Brisbane, B.17): Brisbane Associated Friendly Societies' Medical Institute; Bundaberg Medical Institute. Members accepting LODGE appointments and those desiring to accept appointments to any COUNTRY HOSPITAL or position outside Australia are advised, in their own interests, to submit a copy of their Agreement to the Council before signing.

South Australian Branch (Honorary Secretary, 178, North Terrace, Adelaide): All Lodge appointments in South Australia; all Contract Practice appointments in South Australia.

Western Australian Branch (Honorary Secretary, 205, Saint George's Terrace, Perth): Wiluna Hospital; all Contract Practice appointments in Western Australia.

Editorial Notices.

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